SUPREME COURT OF THE UNITED STATES.

OCTOBER TERM, 1888.

No. 292.

CHARLES MARCHAND, APPELLANT,

vs.

FREDERICK EMKEN.

APPEAL FROM THE CIRCUIT COURT OF THE UNITED STATES FOR THE SOUTHERN DISTRICT OF NEW YORK.

INDEX.

	Original.	Print.
Bill of complaint	1	1
Amendment to bill	6	3
Stipulation as to answer and replication	6	4
Answer	7	4
Replication	12	7
Evidence for complainant	14	8
Testimony of Theodore F. Kionka	14	8
Charles Marchand	26	15
Evidence for defendant	46	27
Testimony of Frederick Emken	46	27
Evidence for complainant in reply	73	43
Testimony of Charles Marchand	73	43
Charles J. Hedrick	101	60
Exhibit—Extracts from scientific works	158	94
Stipulation as to exhibit extracts from scientific works	178	106
Evidence for defendant in sur-rebuttal	181	107
Testimony of Frederick Emken	181	107
Dr. L. H. Friedburg	208	123
Exhibit Patent Office Document 1—Report of Thos. Antisell, examiner	221	131
" " 2—Report of W. H. Chadsey, 1st ass't in charge	222	132
" " 3—Report of Thos. Antisell, examiner	223	132
" " 4—Report of examiners in chief	224	133

JUDD & DETWEILER, PRINTERS, WASHINGTON, DECEMBER 31, 1888.

	Original.	Print.
Evidence for complainant in reply	228	135
Testimony of Charles Marchand	228	135
Exhibit—Table of reactions	233	138
Hearing of cause	237	140
Opinion of Judge Coxe	239	141
Final decree	246	144
Stipulation as to record on appeal	248	144
Claim and allowance of appeal	249	145
Bond	252	145
Citation	257	147
Proof of service of citation	259	147
Clerk's certificate	261	148

1 United States Circuit Court, Southern District of New York.

To the honorable the judges of the circuit court of the United States for the second circuit within and for the southern district of New York, sitting in equity:

Charles Marchand, of the city, county, and State of New York and a citizen of the State of New York, brings this his bill against Frederick Emken, of the city, county, and State of New York and a citizen of the State of New York.

And thereupon your orator complains and says that heretofore, to wit, before the second day of August, 1882, your orator, being the original and first inventor of a certain new and useful improvement in the manufacture of hydrogen peroxide, made application, on said last-mentioned day, in due form of law, to the proper department of the Government of the United States for the grant of its letters patent for such improvement.

And your orator further represents and shows that thereupon such proceedings were had that letters patent of the United States, dated the sixth day of March, 1883, and numbered 273,569, were issued in due form of law and delivered to your orator for the said invention, whereby there was granted to your orator, his heirs and assigns, for the term of seventeen years from the date thereof, the exclusive right to make, use, and vend the said invention throughout the United States and the territories thereof, as in and

2 by a certified copy of the said letters patent, ready to be produced as this court may direct, will more fully appear.

And your orator further shows that he has always, since the grant of the said letters patent and in the exercise of the exclusive rights so granted as aforesaid, made, used, and vended to others to be used the said improvements so patented, and has had and maintained, until the infringement hereinafter complained of, exclusive possession of the said improvements and inventions under and by virtue of said letters patent, and has never acquiesced in any invasion or infringement of his said rights, and that the rights of your orator to the exclusive use and enjoyment of said inventions as covered by said letters patent and acquiesced in by the public have been generally respected.

That one Alexandre Bourgougnon, subsequent to the issuing of said letters patent as aforesaid, began to infringe upon the same in connection with the manufacture of hydrogen peroxide; that thereupon your orator notified said Bourgougnon of such infringement and requested him to desist therefrom; that thereupon said Bourgougnon carefully investigated the facts connected with the validity of said letters patent and, having satisfied himself of the validity thereof, took a license from your orator in which he admitted the validity of said letters patent, and has paid your orator at regular intervals license fees thereunder ever since.

And your orator further shows unto your honors that the defendant herein, having full knowledge of the premises and in violation of your orator's exclusive rights and privileges as aforesaid and utterly disregarding the same, has, since the sixth day of March,

1883, without the license of your orator, at the city of New York and at various other places in the United States, manufactured, used, and sold, and still continues to manufacture, use, and
3 sell, articles embodying and embracing the improvements and inventions described in said letters patent, and that the defendant has used the processes described and claimed in said letters patent and so secured to your orator; to what extent your orator is unable to say, but prays that the defendant may discover and set forth in his answer to this bill.

And your orator further shows unto your honors that he will be subject to great and irreparable injury unless he shall obtain from your honors the relief hereby sought.

To the end, therefore, that the said defendant may, if he can, show why your orator should not have the relief hereby prayed, and may, upon his corporal oath and according to the best and utmost of his knowledge, remembrance, and belief, full, true, direct, and perfect answer make to all and singular the matters hereinbefore stated and charged as fully and particularly as if the same were hereinafter repeated and he thereunto strictly interrogated, and more especially that he may answer and set forth—

1. Whether he has not made or caused to be made, or used, or sold one or more articles embodying and embracing one or more of the improvements and inventions substantially as described and claimed in said letters patent since the date thereof.

2. What amount of said articles so made as aforesaid the defendant has made, used, or sold since the date of said letters patent, and what profit has been made or derived therefrom by the said defendant.

3. Whether the defendant has not used the processes and the improvements or one or more of the processes and improvements described and claimed in said letters patent since the date thereof.

4. To what extent the defendant has used such processes
4 and improvements since the date of said letters patent, and what profit has been made or derived from such use by the said defendant.

And your orator further prays that the said defendant may be forthwith restrained by a writ of injunction, issuing out of and under the seal of this honorable court, from making, using, or vending any article embodying or embracing or manufactured in pursuance of the inventions secured to your orator by virtue of said letters patent number 273,569, and from using the processes and improvements secured to your orator by virtue of said letters patent, and from all violations or infringements of the exclusive rights of your orator under and by virtue of said letters patent, and that on the final hearing of this cause the said injunction may be made perpetual.

And that said defendant may be decreed to account to your orator for all profits realized by him from the manufacture, use, or sale of articles made pursuant to the said inventions so secured to your orator by said letters patent, and from the use of the processes and improvements secured to your orator by said letters patent, in viola-

tion of the exclusive rights of your orator; and also to pay to your orator, in addition to said profits, the damages which have been sustained by your orator by reason of said infringement, and that said damages may be assessed under the direction of this court and increased in its discretion, according to law; and that your orator may have such other and further relief in the premises as the nature of the case may require and as may be according to equity and good conscience, and may recover of the defendant the cost of this suit.

And may it please your honors to grant your orator a writ of subpœna, to be directed to the said defendant, Frederick Emken, commanding him, at a certain day and under a certain penalty, to be and appear before this honorable court, and then and there full, true, direct, and perfect answer to make to all and singular the premises, whether specially interrogated thereto or not, and further to stand to, abide by, and perform such further orders, directions, and decrees therein as to your honors shall seem meet and proper.

C. MARCHAND.

TURNER, LEE & McCLURE,
Complainant's Solicitors.
W. H. L. LEE,
Of Counsel.

UNITED STATES OF AMERICA,
Southern District of New York, } ss:

On this twenty-fifth day of February, 1884, before me, John McClure, a notary public, personally appeared Charles Marchand, the complainant above named, who, being duly sworn, did depose and say that he is such complainant; that he has read the foregoing bill in equity and knows the contents thereof, and that the same is true of his own knowledge, except as to the matters therein stated to be alleged on information and belief, and as to those matters he believes it to be true.

[L. S.]

JOHN McCLURE,
Notary Public, N. Y. Co.

U. S. Circuit Court, Southern District of New York. In Equity.

CHARLES MARCHAND *vs.* FREDERICK EMKEN.

And now comes the complainant into court and amends his bill of complaint by striking out the words "upon his corporal oath and," in the 8th folio thereof, and by adding after the word "repeated," in said folio, the following words: "(answer under oath being hereby expressly waived)."

Dated May 22, 1884.

TURNER, LEE & McCLURE,
Solicitors for Complainant.

U. S. Circuit Court, Southern District of New York.

CHARLES MARCHAND *vs.* FREDERICK EMKEN.

It is hereby stipulated and agreed between the respective parties hereto—

First. That the answer filed in the office of the clerk of the circuit court of the United States for the southern district of
7 New York, in the suit of Charles Marchand against Charles Emken and Frederick Emken, on the 6th day of August, 1883, stand as the answer of the defendant, Frederick Emken, in this suit.

Second. It is further stipulated and agreed that the replication of the complainant filed in the office of the clerk of the United States circuit court for the southern district of New York, in the suit of this complainant *vs.* Charles Emken and Frederick Emken, on the 3d day of September, 1883, stand as the replication in this case.

Third. It is further stipulated that the date of issue be considered as the date of this stipulation.

Dated March 29th, 1884.

MARSHALL P. STAFFORD,
Defendant's Solicitor.

United States Circuit Court, Southern District of New York.

CHARLES MARCHAND
vs.
CHARLES EMKEN and FREDERICK EMKEN.

The answer of Charles Emken and Frederick Emken, defendants, to the bill of complaint of Charles Marchand, complainant.

These defendants, now and at all times hereafter saving
8 and reserving to themselves all and all manner of benefit and advantage of exception which may be had or taken to the manifold errors, uncertainties, imperfections, and insufficiencies of said bill of complaint, for answer thereto, or to so much thereof as they are advised is material or necessary to make answer to, answering, say—

That upon information and belief alone they admit that letters patent of the United States, dated the 6th day of March, 1883, were granted to the complainant, Charles Marchand, for the alleged improvement in the manufacture of hydrogen peroxide, but whether or not said letters patent were applied for and issued in compliance with the provisions and requirements of the law these defendants have no knowledge or information save by said bill of complaint, and cannot set forth, but leave the complainant to make such proof thereof as he may be advised is material. And these defendants, further answering, deny that they have ever in any way infringed upon or are now infringing upon any rights of the complainant as secured to him by said letters patent, and deny that they have ever used or are now using the alleged processes described and

claimed in said letters patent and deny that they have ever manufactured or sold or are now manufacturing, using, or selling articles embodying or embracing any of the alleged improvements and inventions described in said letters patent. And these defendants, further answering, say that they are advised and therefore aver that said letters patent and each and every part thereof are void and of no effect in law, because the specification accompanying the same is not in such full, clear, and exact terms as to enable any person skilled in the art to which it pertains or with which it is most nearly connected to practice the alleged invention, and because the patentee therein did not give to the public the best and utmost of his knowledge as to the making and using said alleged invention, and because, for the purpose of deceiving the public, the de-
9 scription and specification filed by said patentee in the Patent Office were made to contain less than the whole truth relative to said alleged invention or discovery, or more than is necessary to produce the desired result.

And the said defendants, further answering, say that said letters patent and each and every part thereof are void and of no effect in law, because the said alleged inventor was not originally the first inventor or discoverer of any material or substantial part of said alleged invention or discovery, but the same and every material and substantial part thereof had been previously invented and used by and known to the following persons at the places set opposite their names, respectively, who, to the best of defendant's knowledge and belief, now reside at the places respectively specified:

Benjamin Simon, of and at New York city and elsewhere.

Emile Capel, of and at New York city and elsewhere.

And these defendants, further answering, say that said letters patent and each and every part thereof are void and of no effect in law, because the patentee, Charles Marchand, surreptitiously and unjustly obtained the patent of that which in all substantial and material parts thereof had been previously invented and was in use at the establishment of B. Simon & Capel, in the city of New York, where said Marchand saw the same in use before he had or pretended to have made any invention thereof.

And these defendants, further answering, say that said letters patent and each and every part thereof is void and of no effect in law, because said alleged invention in all substantial and material parts thereof had, prior to the supposed or alleged invention or discovery thereof by the complainant, been described in numerous printed publications, and among them the following:

10 Watt's Dictionary of Chemistry, vol. 3, pp. 196 and 197.
Third Supplement of same, vol. 8, part 2, p. 1072.
Fehling's Handbook of Chemistry, vol. 9, pp. 589 and 590.
Muspratt's Chemistry (Kerl & Stohman, 1880), p. 598.
James Prescott Joules' Mechanics.
Fownes' Elementary Chemistry, p. 153.

And these defendants, further answering, say that said letters patent and each and every part thereof are void and of no effect in law, because the said alleged invention or discovery and each

substantial and material part thereof had, prior to said alleged invention or discovery thereof by the complainant, been patented by the following-named persons in and by the following patents:

U. S. letters patent granted to G. Mooney June 3, 1879, No. 216,053.

U. S. letters patent granted to Brower July 14th, 1874, No. 125,895.

U. S. letters patent granted to Deuel March 23, 1869, No. 88016.

U. S. letters patent granted to Markillie August 27, 1861, No. 2150.

U. S. letters patent granted to Lehman September 10, 1872, No. 131,283.

U. S. letters patent granted to Pritchard November 8, 1881, No. 249,256.

U. S. letters patent granted to Tcherniac & Gunzberg December 9, 1879, No. 222,547.

And these defendants, further answering, deny that by virtue of said letters patent the complainant became or still is the exclusive owner of said alleged invention as described and claimed therein, and they deny that he thereby acquired the full and exclusive right and liberty of making, using, and vending to
11 others to be used said alleged invention or any substantial part thereof, or has been in the possession of the exclusive right so to do, save for the alleged infringement by these defendants, as charged in said bill of complaint, and they deny that the public has generally acquiesced in complainant's alleged exclusive right to said invention.

And these defendants, further answering, say that the processes and means described and claimed in said letters patent were well known and had been in general use in this country and in Europe in the production of hydrogen peroxide and in other analogous manufactures for many years prior to the application alleged in complainant's bill of complaint, and that said alleged invention and patent of the complainant does not contain anything novel or any patentable subject-matter whatever.

And these defendants pray the same benefit of the facts and things therein set forth as if for reason thereof the said bill had been demurred to when a demurrer would have been proper, and the same benefit thereof as if they had been specially pleaded to said bill.

And these defendants submit to this honorable court that said complainant has no right to any further answer to said bill or to any part thereof than is hereinbefore contained, and no right to any injunction, account, or other relief prayed for in said bill; and these defendants pray to be hence dismissed with their reasonable costs and charges in this behalf most wrongfully sustained.

FREDERICK EMKEN.
CHARLES EMKEN.

STAFFORD & GRAFF,
Plaintiff's Solicitors.
MARSHALL P. STAFFORD, Esq.,
Of Counsel.

SOUTHERN DISTRICT OF NEW YORK, } ss:
City and County of New York, }

On this 6th day of August, 1883, personally appeared before me Frederick Emken and Charles Emken, who, being by me severally and duly sworn, each for himself deposes and says that he has heard read the foregoing answer and knows the contents thereof, and the same is true of his own knowledge except as to matters therein stated to be alleged on information and belief, and as to those matters he believes it to be true.

CHARLES EMKEN.
FREDERICK EMKEN.

Sworn to before me this 6th day of March, 1883.
[L. S.] JAMES KNOX,
Notary Public, City and County of New York,
State of New York.

Circuit Court of the United States for the Southern District of New York.

CHARLES MARCHAND
vs.
CHARLES EMKEN and FREDERICK EMKEN.

These repliants, saving and reserving unto themselves all and all manner of advantage of exception to the manifold insuffi-
13 ciencies of the said answer, for replication thereunto say that they will aver and prove their said bill to be true, certain, and sufficient in the law to be answered unto, and that the said answer of the defendants is uncertain, untrue, and insufficient to be replied unto by these repliants, without this, that any other matter or thing whatsoever in the said answer contained material or effectual in the law to be replied unto, confessed and avoided, traversed or denied, is true; all which matters and things these repliants are and will be ready to aver and prove as this honorable court shall direct, and humbly pray as in and by their said bill they have already prayed.

Dated New York, September 3, 1883.

TURNER, LEE & McCLURE,
Complainant's Solicitors.

14 United States Circuit Court, Southern District of New York.
In Equity.

CHARLES MARCHAND *vs.* FREDERICK EMKEN.

Testimony taken on the part of the complainant, under and pursuant to the 67th rule of the Supreme Court of the United States, as amended, before John A. Shields, Esq., a standing examiner of said court.

NEW YORK, *May 27th*, 1884—3 o'clock p. m.

Present: W. H. L. Lee, Esq., of counsel for complainant, and Marshall P. Stafford, Esq., of counsel for defendant.

THEODORE F. KIONKA, a witness produced on behalf of the complainant, being duly sworn, testified as follows:

Q. 1. What is your name, age, residence, and occupation?

A. Theodore F. Kionka; my age is 33; I reside in Brooklyn, and I am a manufacturing chemist.

Q. 2. Do you know the defendant, Frederick Emken?

A. Yes.

Q. 3. State whether you have ever been in the employ of said Frederick Emken. And, if so, when did your employment begin, when did it cease, and where was his place of business during that time?

15 A. I was there from July or August, 1883, to February, 1884, to take charge of the boiler and to make hydrofluoric acid and other things; his place of business was 330 and 332 East 60th street, New York city.

Q. 4. State whether or not said Frederick Emken, while you were in his employ, ever manufactured hydrogen peroxide.

A. Yes.

Q. 5. What materials were used by him in making such hydrogen peroxide?

A. Some kinds of acid, binoxide of barium, and water.

Q. 6. State whether or not you remember the construction of the vessel in which the materials were placed to be converted into hydrogen peroxide, and the devices used to mix the same.

A. Yes.

Q. 7. Look upon the sketch that I now show you and state what it is.

A. That is a wooden vessel containing about 150 gallons, with a stirrer in the centre, which is supported on the bottom by a glass plate and driven by a rope and steam power.

Q. 8. Where did you ever see the vessel and stirring devices which the sketch represents?

A. At the same time when I was there, in the place of business of the defendant, number 330 and 332 East 60th street.

Counsel for complainant offers in evidence the sketch referred to, and the same is marked Complainant's Exhibit Sketch, May 27th, 1884, J. A. S., examiner.

Cross-examination as to exhibit offered:

X Q. 9. Did you draw this sketch?
A. Yes.
X Q. 10. Did you do it alone and from memory?
A. Yes.
X Q. 11. On the premises of the defendant?
16 A. No; not on the premises of the defendant.
X Q. 12. When and where?
A. Yesterday, at Mr. Marchand's place, corner of Horatio and West streets. Mr. Marchand is the complainant.
X Q. 13. Were you alone at the time you drew it?
A. Not always. Mr. Marchand was there and Mr. Lee.
X Q. 14. Was any suggestion made to you by any one in regard to the drawing of it?
A. No.

Direct examination continued:

Q. 15. What do the parts of said sketch represent which are marked A?
A. The vessel.
Q. 16. The vessel in which the mixture was placed?
A. It represents the vessel.
Q. 17. What was the size and shape of this vessel, and of what material was it made?
A. It was made from wood, three feet high, and three to four feet wide. It was like a wash-tub—a little higher; it was round.
Q. 18. Describe the devices marked B and C in the sketch, and state of what material they were made.
A. B is a wooden square beam; it is round at the points D; and C are wooden flies attached to the beam B.
Q. 19. How are these two flies situated relatively to one another; are they on the same plane?
A. They are on the same plane.
Q. 20. Describe the parts which are shown in the drawing immediately above and below the upper right-hand wing C?
A. These are two boards, which have been marked E, fast-
17 ened by a piece of board on the tub.
Q. 21. Point out the piece of board on the drawing.
A. These are the boards (pointing to E and E).
Q. 22. What is the part that is marked F?
A. That is a vertical piece of wood fastened to the side of the tub, and E and E are fastened to this.
Q. 23. Now, are the wings C C stationary or do they revolve?
A. They are revolved with the shaft B.
Q. 24. How is motion imparted to the shaft B?
A. By a pulley, G.
Q. 25. And what do the dotted lines going from the pulley G represent?
A. That is a rope running around the pulley.
Q. 26. Now, please describe the method of making hydrogen perox-

ide in this vessel, as practised by Mr. Emken while you were with him.

A. They put in water and some acid, after this barium till it was nearly neutralized, acid again and barium, etc., and the operation was repeated twice or three or four times until the mixture was strong enough.

Q. 27. What preparation of barium was used?

A. Binoxide of barium.

Q. 28. Now, from the time that the acid and water was first put in what, if anything, was being done in the tub?

A. The machinery was set in motion.

Q. 29. What was the nature of this motion—was it irregular or constant?

A. It was constant.

Q. 30. How rapidly should you think that the wings C revolved in the tub?

Objected to—what he thinks; must confine himself to what he knows.

A. About 50 to 100 revolutions in a minute.

Q. 31. What was the function of the board E?

A. To stop the circulating motion of the water.

18 Q. 32. While this mixing process was going on by the rotation of the wings what was the temperature of the mixture?

A. Between 70 and 90° F.

Q. 33. State whether or not any means was used to lower this temperature.

A. They cooled it by using ice.

Q. 34. How was the ice used?

A. In a separate tank, from which comes a pipe to the vessel.

Q. 35. Did anything come through this pipe to the vessel?

A. Ice water or cool air goes through to the vessel in the pipe, which goes around the bottom and comes out at the side.

Q. 36. How much would this cool the mixture?

A. To keep it between 70 and 90° F.

Q. 37. What is the object of keeping the temperature down?

A. When the temperature is too high it will decompose the peroxide of hydrogen.

Q. 38. In the sketch there is a small portion near the bottom which is colored blue. What is this part and of what is it made?

A. That is a glass plate to support the stirring beam B.

Q. 39. Just above this part which is colored blue there seems to be a portion raised slightly above the bottom of the tub A on either side of the lower end of the rod B. What is this part and what is its function? It has been marked H.

A. That is a round wooden piece of board with a hole in the centre to be a guide for the stirring beam.

Q. 40. In order to thoroughly complete the mixture of the ingredients, how long was it necessary to continue the revolution of the shaft and wings in the mixture?

A. Three to five hours, according to the quantity.

19 Q. 41. Did the time vary at all in accordance with the strength of the hydrogen peroxide which was desired?

A. Yes.

Q. 42. What is the part "I" shown in the sketch—of what was it made and what was its function?

A. That is a strong wooden cross-beam with a hollow to hold the stirring beam B in position.

Q. 43. What are the small drawings on the upper left-hand side of the Exhibit Sketch?

A. Different views of the same beam I. The lower one of the two is the top view of the beam I and the other is a side view of a vertical section at right angles to that shown in the main figure of the sketch.

Q. 44. What experience have you ever had in the manufacture of hydrogen peroxide?

A. I was engaged for two years in making peroxide hydrogen, from 1881 to 1883.

Q. 45. Can hydrogen peroxide be made by hand?

A. Yes; I did it.

Q. 46. Is it made by the same ingredients that you have described when made by hand?

A. By the same ingredients and in the same manner.

Q. 47. How long would it take to complete the mixture when it is done by hand?

A. About twice the time.

Q. 48. And how large an amount of hydrogen peroxide could be mixed by one person at one time by hand?

A. About twenty gallons.

Q. 49. State whether or not the liability of wasting the material was greater or less when done by hand.

A. It was greater, because the work by hand cannot be done quick enough.

Q. 50. And if it was not done quickly enough what was the result?

A. I lost oxygen.

Q. 51. Was this on account of the reaction?

20 A. Yes.

Q. 52. In what part of Mr. Emken's place of business was the manufacture of hydrogen peroxide carried on?

A. In the rear.

Q. 53. In which story of the building?

A. In the second story.

Q. 54. What means of access to this portion of the building was there?

A. There was a small stairs from the yard over the roof of the rear building to the room where the hydrogen peroxide was made.

Q. 55. Was not this room in the rear building?

A. There was but one building, but it was higher in the rear part than in the front.

Q. 56. State whether or not the defendant allowed any one to go into the room where he made his hydrogen peroxide.

A. No; only on business.

Q. 57. Was he more particular about keeping people out of that part of his place of business?

A. Yes; he was more particular about this part.

Q. 58. You say, in answer to the 56th question, that no one was allowed in the room referred to "only on business." What do you mean by that?

A. I mean the employees there.

Q. 59. Have you any interest whatever in this controversy?

A. No.

Q. 60. What is your native language?

A. German.

Q. 61. In regard to the part F in the sketch are you sure that it did not extend lower down toward the bottom of the tub than is shown in said sketch?

A. I remember me not quite whether the part F is lower than shown in the sketch, but I think the sketch is nearly right.

Adjourned to Saturday, May 31st, 1884, at 2 p. m.

21 NEW YORK, *May* 31, 1884—2 p. m.

Present: Counsel as before.

THEODORE F. KIONKA cross-examined by Mr. STAFFORD:

X Q. 62. Did you have anything to do with the manufacture of hydrogen peroxide in the defendant's establishment?

A. No.

X Q. 63. How did you obtain a knowledge of the apparatus used by them in the manufacture of hydrogen peroxide?

A. I was passing through the room used for the manufacture of hydrogen peroxide.

X Q. 64. When was this?

A. Same time I was employed there.

X Q. 65. Did you make a careful examination of that apparatus?

A. Not a careful; but it was so simple and easy I could see it.

X Q. 66. Did your duties, when in the defendant's employ, necessitate any examination of this apparatus by you?

A. No.

X Q. 67. How many times did you examine it?

A. I think I was in this room about every day, and I saw it.

X Q. 68. Where were you engaged for two years in the manufacture of hydrogen peroxide?

A. The first time by Bourgougnon & Co., 26 West 4th street, New York city, and then in my own business with the firm of Baumann & Kionka, at 86 South 5th avenue, New York city.

X Q. 69. Why would it take twice as long to manufacture hydrogen peroxide if the stirring were done by hand as it would if done by the defendant's apparatus?

A. You can only make a small quantity; a large quantity would be too hard to stir by hand.

22 X Q. 70. How large a quantity was contained in the defendant's apparatus at one time?

A. I cannot tell that.

X Q. 71. Can you give an estimate? How much would the tank in defendant's apparatus hold?

A. I think it would hold one hundred and fifty gallons.

X Q. 72. What did you say the dimensions of it were?

A. It was three or three feet and a half high by three feet six inches or four feet diameter.

X Q. 73. Then do you say that, in your estimation, a vessel of those dimensions would hold about 150 gallons?

A. Yes.

X Q. 74. You say it was not full?

A. It was not quite full.

X Q. 75. What is the difficulty of stirring liquid by hand when it is only three feet or less deep?

A. At first, nothing. It will get thicker and more compact.

X Q. 76. Would there be any difficulty in stirring it sufficiently by hand if you employed two or three men?

A. I could not say that, but I think it would be better if the men were employed.

X Q. 77. Then, in your opinion, the only advantage of the apparatus over stirring it by hand is in saving the time of the men employed?

Objected to as not cross-examination, and notice is given that defendant in asking this question and questions of a similar nature makes the witness his own.

A. It saves time.

X Q. 78. You think that even a better article of hydrogen
23 peroxide could be made by stirring by hand than is made by stirring by the defendant's apparatus?

Same objection and notice, and also objected to as assuming what the witness has not said.

A. There can be no difference in the quality of the peroxide hydrogen.

X Q. 79. Does the difficulty of properly stirring the mixture depend in any way upon the quality or kind of barium used as to its being more finely pulverized?

A. It don't affect it.

X Q. 80. There is a difference, is there not, in barium, some being much finer ground than the other?

A. Yes; it is different in the market.

X Q. 81. When the barium is very fine—that is, when the separate particles are very small—does it not mix more readily and render the stirring process easier than when the barium is less fine?

A. It will be easier.

X Q. 82. What is the object of stirring the mixture during the process of manufacturing hydrogen peroxide?

Q. 5. Are you the patentee of said letters patent No. 273,569?

A. Yes, sir.

Q. 6. Have you read said letters patent, and do you understand the same?

A. Yes, sir.

Q. 7. Have you read the deposition of Theodore F. Kionka in this suit, and do you understand the same, and have you examined Complainant's Exhibit Sketch in connection with said deposition, and do you understand the same, and do you understand the construction of the apparatus shown in said sketch, and the method of making hydrogen peroxide as described in said deposition and illustrated by said sketch?

A. Yes, sir.

Q. 8. Please compare the first claim of letters patent 273,569 with the method of making hydrogen peroxide which the witness, Kionka, states is used by the defendant and as described by him in his said deposition.

Counsel for defendant objects to the question, 1st, on the ground that this witness is not shown to be an expert in the construction and use of mechanical apparatus and appliances; 2d, that he, being a party in interest, is not a competent witness in the matter to which the question relates.

A. The first claim of the patent 273,569 reads as follows: "The method of making hydrogen peroxide by cooling the acid solution, imparting thereto a continuous movement of rotation, as well
28 in vertical as in horizontal planes—such, for example, as imparted by a revolving screw in a receptacle—and adding to said acid solution the binoxide in small quantities, while maintaining the low temperature and the rotary or eddying movements, substantially as described." According to the description given by the witness Kionka, I understand that the method of making hydrogen peroxide used by the defendant is exactly the method described in said first claim of said patent. The method used by the defendant is as follows: He uses a receptacle in which the acid solution is kept at a low temperature. A continuous movement of rotation is imparted to it as well in vertical as in horizontal planes, and the result is exactly the same as it would be by using the revolving screw or any other suitable arrangement, and the defendant is adding to said acid solution the binoxide of barium in small quantities while maintaining the low temperature and the rotary or eddying movements.

Defendant's counsel moved to strike out the entire answer as not being competent, material, or relevant testimony nor responsive to the question, for the reason that the issue raised by the pleadings and the question put to the witness calls for nothing but the comparison of one mechanical apparatus with another, while the witness has testified to nothing of the kind, but has talked entirely about acid solution and the results of certain movements instead of con-

fining himself to the method of producing such movements and results.

Q. 9. Have you ever made hydrogen peroxide by hand, without the use of machinery?

A. Yes, sir.

29 Q. 10. What is the ordinary method of making hydrogen peroxide by hand?

Objected to as irrelevant and immaterial, and also on the ground that the witness is bound by his own statement in that regard in his letters patent, which are in evidence, and is limited to that statement.

A. The ordinary method of making hydrogen peroxide by hand is described in the letters patent No. 273,569, and it reads as follows: "Heretofore hydrogen peroxide has been made by adding the barium or calcium binoxide, mixed with water, to the diluted acid, binoxide being added, from time to time, in small quantities, the vessel in which the operation is conducted being set in a refrigerating medium and the liquid being agitated or stirred to facilitate the reaction. The stirring has been performed by hand."

Q. 11. You say that the stirring was performed by hand; how was it done; by what means?

A. The stirring performed by hand was made by means of a stick of suitable material, and it was larger at the lower part; it was something like an oar.

Q. 12. When the hydrogen peroxide was made by hand what was the largest-sized vessel that could be conveniently used?

A. About forty to forty-five gallon capacity.

Q. 13. With a vessel of that size, how much hydrogen peroxide could a man manufacture in a day?

Objected to as irrelevant and immaterial.

A. A man could manufacture about thirty gallons, this according to the concentration of the solution. I mean, for example, he could manufacture thirty gallons at fifteen volumes capacity.

30 Q. 14. What do you mean by the expression fifteen volumes capacity?

A. I mean that if you decompose, for example, one quart of this hydrogen peroxide solution the result of the decomposition will be fifteen quarts of oxygen gas for one quart of plain water.

Q. 15. Was it more difficult to manufacture when the concentration of the solution became greater?

A. Yes.

Q. 16. In stirring by hand state whether or not it was necessary to keep the mixture in motion all the time; and, if so, why?

A. Yes; it is necessary to keep the mixture in motion during all the time that the chemical reaction takes place. The reason of the necessity of keeping this constant motion is that so soon as you stop for a little while, even two or three seconds, the particles of binoxide of barium cease to be brought in contact with new parts of acid solution, and consequently the reaction is interrupted, and when

the motion is begun again a loss of oxygen could not be prevented at that moment.

Q. 17. Was the labor of stirring the mixture by hand severe in its nature?

Objected to as irrelevant and immaterial.

A. Yes, sir; it is very severe. At the beginning of the operation it is comparatively easy, but after an hour or so the mixture becomes pretty dense and the density keeps increasing during the process, which makes it very hard for a man to continue the stirring, and he must be relieved after a short time of labor.

Q. 18. State how many persons it was necessary to employ for each kettle in making the hydrogen peroxide by hand.

Objected to as irrelevant and immaterial.

31 A. It was necessary to employ two men, one relieving the other when he got tired stirring.

Q. 19. In making hydrogen peroxide by the method described in your patent how large vessels have you customarily used?

A. I used some kettles of 150 gallons, some of seventy to seventy-five gallons, and I use now a kettle or vessel which is about 800 gallons.

Q. 20. Does the number of gallons in your last answer refer to the size of the kettle—that is, its capacity to hold so many gallons of liquid motionless—or does it refer to its capacity for making so many gallons of hydrogen peroxide?

A. I can work about seven hundred and fifty gallons in the vessel having a capacity of 800 gallons.

Q. 21. Please state why the vessels that you formerly used were of a capacity not over 150 gallons or thereabouts.

Same objection.

A. Because I had not the facilities which I have now to use larger kettles.

Q. 22. When did you move to your present place of business, and where were you located previous to that time?

Same objection.

A. I moved to my present place of business in May, 1883. Previous to that I had my place corner of Bank street and 13th avenue, New York city, and previously to that at 635 Broadway.

Q. 23. Is there any practical difficulty in making hydrogen peroxide in such large vessels as that referred to in your answer to question 20, when your patented process is used?

Same objection.

A. No; there is not.

32 Q. 24. Prior to the time that you invented the apparatus and process shown and described in letters patent 273,569, did you ever know of hydrogen peroxide having been made otherwise than by hand?

(Objected to as containing an assumption that he did invent the apparatus — process described in the patent, and also as irrelevant and immaterial.)

A. No, sir. I never knew of hydrogen peroxide having been made otherwise than by hand.

Q. 25. You have already stated that when hydrogen peroxide is made by hand it is necessary to keep the mixture continuously in motion by stirring without interruption. By your patented process a continuous movement of rotation is also effected; please state what, if any, differences there are between the movement given by hand and that given by your apparatus and process.

A. When the movement is given by hand it is very irregular and does not stir the whole mass at the same time, and, consequently, it allows the binoxide of barium to settle at the bottom of the kettle, because the stick used can only put in motion the binoxide of barium when it touches it. By my patented process the movement of rotation in both ways, horizontally and vertically, prevents the particles of binoxide of barium to settle at the bottom of the kettle, and consequently the particles are constantly kept in suspension in the mass, which makes the chemical reaction a very regular one without any interruption, whereas in stirring by hand it is perfectly impossible to obtain the same result.

Q. 26. Why is it that the binoxide of barium tends to settle at the bottom?

Objected to as irrelevant and immaterial.

33 A. Because the specific gravity or density of binoxide of barium is about three times greater than the density of the liquid, and it settles down very easy.

Q. 27. You say that by the settling of the binoxide of barium that which settles is prevented from coming in contact with the acid solution. How does this interfere with the perfection of the process and tend to make it less effective?

A. When the particles of binoxide settle at the bottom the chemical reaction is temporarily interrupted, and after a while when the particles are put in motion they are brought in contact with the acid, and the result of this interruption occasions a loss of oxygen gas, which escapes and consequently does not combine with hydrogen to make peroxide of hydrogen. The yielding is then diminished in a proportion which varies with the irregularity of the movement.

Q. 28. Then, as I understand it, the most perfect and economical reaction is obtained when every particle of the binoxide of barium is constantly brought in contact with new parts of the acids. State whether or not this is correct.

A. Yes, sir; there is no doubt about it.

Q. 29. Please state whether or not the method of making peroxide of hydrogen claimed in the first claim of your patent sued upon can be practiced by hand.

Objected to on the ground that the process described in the patent

is by machinery, and of course the process of manufacturing by machinery cannot be done by hand.

A. No, sir; it cannot.

Q. 30. Then, so far as the motion imparted by hand and the motion of your patent are concerned, state what, if any, are
34 the distinctions of the character of the motion produced by hand and that produced by your process and apparatus.

Objected to as having been already answered at great length and with great minuteness.

A. The motion imparted by hand could never bring in contact every particle of binoxide of barium with new parts of acid, whereas by my patented process the movement changes constantly the surfaces in contact, and consequently the chemical reaction has no interruption.

Q. 31. The claim of your patent speaks of a continuous movement of rotation, as well in vertical as in horizontal planes. Please state whether or not there is any advantage in this complex movement, and also whether or not there is any difference in this respect between your process and the process of manufacture by hand.

Objected to as being another repetition of the question which was last answered.

A. There is a great advantage in this complex movement claimed in my patent, and it is an impossibility to obtain such movement by hand; the difference has been explained by me previously.

Q. 32. State whether it is possible to regulate the rapidity of movement more readily and exactly by your method or by hand.

A. It is very easy to regulate the rapidity of movement by my patented method, and it is impossible to do so by hand.

Q. 33. Your patent speaks of cooling the acid solution; please explain the necessity of doing this.

Objected to as irrelevant and immaterial.

35 A. It is necessary to keep the mixture at a comparatively low temperature, which should not exceed 70 to 80 degrees Fahrenheit, because above that temperature the peroxide of hydrogen is decomposed and gives off the oxygen, and a loss is the consequence.

Q. 34. Is there any novelty in cooling the mixture?

A. No, sir.

Q. 35. It says in the first claim of your patent that the binoxide is added to the acid solution in small quantities. Will you please state more fully what is meant by this, and describe how you are in the habit of carrying out your patented process in your own business?

Objected to as irrelevant and immaterial.

A. If I should put at once the whole quantity of binoxide of barium necessary to neutralize the whole quantity of acid the reaction would generate in a very short time a great quantity of heat,

which I could not prevent from becoming so high as to decompose the peroxide of hydrogen. I carry out my patented process in my own business as follows: First, I put in the kettle a certain quantity of water and acid; then I put the stirring apparatus in motion and I add to the acid solution little by little the binoxide of barium, which has been properly hydrated, until the quantity of acid which was put at first in the kettle should be nearly neutralized; then I put in a new quantity of acid, to which I add some new quantity of binoxide of barium little by little; then acid again and binoxide again and again, until I reach the proper concentration required for the trade, and of course I keep the stirring apparatus in motion during all the time.

Q. 36. About how much binoxide of barium are you in the habit of putting in at a time?

Same objection.

36 A. About three to five pounds, according to the quantity of the peroxide to be manufactured, every two or three minutes.

Q. 37. Please state whether or not you ever put the whole of the acid solution in the kettle first and then add the binoxide of barium little by little without subsequently putting in any more acid solution?

Objected to as irrelevant and immaterial, and also as having been already fully and minutely answered.

A. I proceed in both ways indifferently.

Q. 38. By both ways do you mean the method described in your answer to question 35 and the method described in question 37?

A. Yes.

Q. 39. Please state whether or not, in your opinion, there is any material difference between these two ways or methods?

A. No.

Q. 40. Please state whether not at the time of the date of your patent, March 6th, 1883, you were in the habit of proceeding in both ways.

Objected to as irrelevant and immaterial, and on the ground the complainant is bound by what is described in his patent, and that the evidence should be limited to what he there describes.

A. Yes.

Q. 41. You have spoken of your 150-gallon kettles. How many gallons of hydrogen peroxide can be made at a time in a kettle of this size?

A. About 135 gallons.

Q. 42. How long does it take to complete the manufacture of that quantity in one kettle of this size by your process?

A. It requires about four hours.

Q. 43. And how many persons to attend to it?

37 A. One.

Q. 44. How many kettles have you ever had going at once?

Objected to as irrelevant and immaterial.

A. Ten; two of 150 gallons and eight of 70 gallons or thereabouts

Q. 45. How many persons does it take to attend to these ten kettles?

A. One person attends to them all.

Q. 46. After your process has been completed does it not require more than one person to attend to it?

Objected to as irrelevant and immatarial, as we have nothing to do with the number of men he employs after the process he describes in his patent is complete.

A. After the process has been completed I generally employ two or three men to clarify the peroxide and put it in a marketable condition; but that does not refer to my patent.

Q. 47. You stated in answer to Q. 45 that it took one person to attend to these ten kettles. What is the nature of the work that this one person has to do?

Objected to as irrelevant and immaterial.

A. That person has to put in the kettles the proper quantities of the binoxide of barium and acid solution and to test from time to time with a litmus paper in order to see if the mixture has become neutral, and superintend the reaction.

Q. 48. Is this work exhausting or severe?

38 A. Not at all.

Adjourned to Monday, June 23d, at 10.30 a. m.

NEW YORK, *June* 23, 1884.

Met pursuant to adjournment.

Present: Counsel as before.

Direct examination of the witness MARCHAND continued:

Q. 49. Please refer to the apparatus shown in Complainant's Exhibit Sketch. You have already stated that by using this apparatus in the manner described by Mr. Kionka a continuous movement of rotation as well in vertical as in horizontal planes was produced in the liquid. Will you please explain how this is?

Objected to, 1st, on the ground that this witness is not shown to be a mechanical expert and so competent to testify on the subject inquired about, and, 2d, because, being the complainant and interested party in this suit, he is not a competent witness.

A. I see on this sketch a tub marked A, in the center of which a vertical shaft, B, rests in the center of the bottom of the tub. This vertical shaft is provided with four blades, marked C C C C. On the inside of the tub I see two projecting pieces, marked E E. At the upper part of the shaft B this shaft passes through a guide, I. At the top of the shaft is fixed a pulley, G, which is put in motion by suitable means. Now, it is easy to see that when the tub will receive the proper quantity of liquid and chemicals which

39 have to be treated, the shaft B being put in motion, the four blades C C C C will give to the liquid a rotary motion, which

will bring the liquid against the sides of the tub, and the liquid having a centrifugal motion, and it being an impossibility for it to pass through the sides of the tub, it will rise up and fall down again and again and produces changing eddies in the mass. The rotary movement is stopped partially by means of the projecting pieces marked E. These projecting pieces act also to produce the horizontal and vertical motion of the particles of the mass, because when the particles come to strike against these projecting pieces they have to raise up and fall down, and so on during the time the shaft is in motion. I mean by that that by horizontal and vertical rotary motion the particles of the mass are constantly brought up and down and do not settle at the bottom. Of course, the rapidity of the movement of the shaft must be kept at a suitable amount of revolutions per minute. Any similar stirring apparatus will produce the changing eddies which make the basis of my patent, as the apparatus shown in it is preferably employed, which means that any other suitable similar arrangement would answer to carry on my patented process.

Q. 50. Have you ever in your business actually used the 800-gallon kettle spoken of in a former part of your deposition?

Objected to as irrelevant and immaterial.

A. No; not yet; I use it to-morrow.

Counsel for defendant moves to strike out that which refers to what witness is going to do hereafter.

Q. 51. Why have you not used it before?

Same objection.

40 A. Because I had no need to use it yet.

Q. 52. How long have you had it in your possession?

Same objection.

A. Since last Thursday.

Q. 53. Of what country are you a native?

A. Of France.

Q. 54. How long have you been in the United States?

A. Nearly seven years—a little over six years.

Cross-examination by Mr. STAFFORD:

X Q. 55. How long have you been a citizen?

A. Since January, 1881, or thereabouts.

X Q. 56. Were you familiar with the leading text books on chemistry at the time you were graduated by the French Government, as you say?

A. Yes; of course.

X Q. 57. Do you read German?

A. No, sir.

X Q. 58. State the text books on chemistry with which you were familiar and which you had studied or read at the time of your graduation at Paris.

A. The leading books were the chemistry of Mr. Cahours, the chemistry of Riche, Regnault, Pelouze, and Fremy, and the Dictionary of Chemistry of Wurtz, which was in the course of publication during the time I was at school.

X Q. 59. Were you familiar with any German works on chemistry?

A. No.

X Q. 60. Did you ever hear of Fehling's Hand Book of Chemistry?

A. Yes.

X Q. 61. Did you see descriptions or directions for making hydrogen peroxide in the books you have mentioned?

A. During the time I was at school, no; since, in some of these books, I have.

41 X Q. 62. How long do you understand that the article hydrogen peroxide has been well known to chemists?

A. It was discovered in 1818.

X Q. 63. At how early a date do you think hydrogen peroxide is described in any text book on chemistry?

A. Thenard published his process in 1818, and all the text books published since are the reproduction or about the reproduction of the process published by Thenard, and this process is mentioned also in the text of my patent.

X Q. 64. Does Thenard mention stirring as a part of the process of producing hydrogen peroxide?

A. Thenard mentions stirring.

X Q. 65. What is the object of stiring in the process of producing hydrogen peroxide?

A. To make the reaction take place.

X Q. 66. How does the stirring aid reaction?

A. By bringing in contact the particles of the different chemicals which have to act each on the other when they are brought together.

X Q. 67. Has stirring any other object or virtue?

A. No; it has no other object.

X Q. 68. Does not any kind of motion which brings the particles of barium in rapid contact with fresh particles of the mixture serve the purpose of stirring equally well with any other?

A. Do you mean that so far as you can bring in contact the fresh particles of the different chemicals brought together any kind of motion is indifferent?

X Q. 69. Yes.

A. The motion is not indifferent for the case.

X Q. 70. What is the advantage of one motion over another?

A. The advantage of the motion mentioned in my patent over any other motion is that it produces regular changing eddies as well as in horizonal as in vertical planes, which is very important

42 for the case and constitutes the advantage over any other motion.

Counsel for defendant moves to strike out this answer as not responsive.

X Q. 71. (Question repeated.)

Counsel for complainant objects to this question as already fully and fairly answered.

A. I give the same answer as before.

X Q. 72. (Question repeated.)

Same objection by complainant's counsel.

A. I add to my answer to X Q. 66 that the motion which I mention has the advantage over any other of producing the regularity in the chemical reaction.

X Q. 73. You have stated that the only purpose of stirring the mixture at all in the process of making hydrogen peroxide is to bring the particles of barium in contact with fresh particles of the acid mixture. If one motion accomplishes this as well as another are not the two equally good for the purpose?

A. Of course they are equally good, so far as they accomplish the same result.

X Q. 74. Then the only advantage of one motion or movement over another is that it brings the particles of barium and the mixture in contact more rapidly and thoroughly?

A. Yes.

X Q. 75. The only object sought to be gained by producing what you call motion in horizontal and vertical planes and ever-changing eddies is to mix the particles more thoroughly—that is,
43 to bring the particles of barium in contact with fresh particles of the acid—is it not?

A. Yes; it is.

X Q. 76. Can you not produce changing eddies and motion in horizontal and vertical direction by stirring a liquid with a stick?

A. Not regularly; you cannot obtain by using a stick a movement in horizontal and vertical planes, bringing up and down the particles brought in contact with regularity.

X Q. 77. I ask you nothing about regularity. I ask you if you say that changing eddies and currents and what you call motion in horizontal and vertical planes cannot be produced by stirring a liquid with a stick?

A. Of course it can be produced.

X Q. 78. Has a screw ever been used to aid in mixing the particles in the manufacture of chemicals?

A. It has.

X Q. 79. How long have you known of a screw being used for that purpose?

A. Since about fifteen years.

X Q. 80. Cooling the mixture during the process of manufacturing hydrogen peroxide, so as to keep it below the temperature at which the hydrogen peroxide decomposes, is mentioned in all text books, such as you have spoken of, is it not?

A. Yes, sir.

X Q. 81. In your direct examination you say that prior to your invention you never knew of hydrogen peroxide being made otherwise than by hand; did you ever read such an expression as manufacturing a chemical by hand?

A. Yes, sir.

X Q. 82. What do you understand that term to mean?

A. I understand that term to mean peroxide of hydrogen was manufactured by means of a stick without any mechanical arrangement.

44 X Q. 83. Could not an apparatus such as is described in your patent be moved by hand?

A. No, sir; not without some mechanical arrangement.

X Q. 84. Suppose a kettle or receptacle such as your patent describes, but having a capacity to hold only two gallons of liquid, then suppose a shaft with blades, such as you describe, made to fit a vessel of that size, could not a man turn that shaft and the blades by his hands?

A. No, sir; not practically.

X Q. 85. How do you understand that what you call motion in horizontal and vertical planes is produced by the apparatus described in your patent?

A. The blades fixed upon the lower part of the shaft, being put in a rotary motion, will impart to the liquid a horizontal centrifugal movement, which will bring the particles of the mixture against the sides of the kettle, and as they cannot pass through the sides of the kettle they will have to rise up and fall down, and so on.

X Q. 86. Does not the entire mass of liquid get in motion in the same direction in which your blades *a* move?

A. Of course it goes in the same direction, but with eddies.

X Q. 87. Now, what specially causes the eddies in the use of your apparatus, aside from the rising and falling which you say takes place in the liquid?

A. When the blades displace the liquid which is directly in front of it the comparative vacuum which is produced behind it by the rotation is filled up by the liquid which is displaced in front.

X Q. 88. Would not the rising and falling in the kettle result if the mixture is stirred with a stick by hand?

A. Certainly not.

X Q. 89. Why not?

A. Because by stirring with a stick you cannot produce the
45 propulsion movement which you can produce with the blades mentioned, and it is precisely this movement of propulsion which is produced by the blades in connection with the sides of the kettle which produces the rising up and falling down.

X Q. 90. Can't liquid be stirred with a stick so as to set the entire mass of it in rotary motion in the same direction in which the stick is moved?

A. Of course.

X Q. 91. Does not motion so produced raise a centrifugal force in the liquid, such as you have spoken of in other parts of your testimony?

A. Yes, if the stick remains at the center and turns all the time on the center as a pivot.

X Q. 92. Is not what you have spoken of as the centrifugal force caused entirely by the rotary motion of the liquid?

A. No, sir.

X Q. 93. What else causes centrifugal force?

A. The propulsion.

X Q. 94. What does the propulsion do except to set the liquid in a rotary motion?

A. It carries away the liquid in front of the blade, which liquid strikes the inside of the kettle; then the blade, being in motion, will not allow the liquid to go in a way contrary to its motion, and consequently it will have to raise up and fall down around the kettle.

X Q. 95. Is centrifugal force caused by anything except the disposition of the moving liquid to change from a rotary motion to motion in a straight line?

A. No.

X Q. 96. Then, if stirring liquid with a stick by hand puts the liquid in a rotary motion, as you have stated, and the rotary motion is what causes the centrifugal force, does not this method of stirring make the liquid rise higher at the circumference and then fall, as you have spoken of in your testimony?

A. Yes.

46 X Q. 97. Then stirring by hand would produce eddies to some extent, would it not?

A. Yes; it will produce eddies to some extent.

C. MARCHAND.

Sworn before me—

JOHN A. SHIELDS, *Examiner.*

Complainant closes his *prima facie* proofs.

United States Circuit Court, Southern District of New York. In Equity.

CHARLES MARCHAND *vs.* FREDERICK EMKEN.

Testimony taken on the part of the defendant, under and pursuant to the 67th Rule of the Supreme Court of the United States, as amended, before John A. Shields, Esq., a standing examiner of said court.

NEW YORK, *August 1st*, 1884.

Present: Marshall P. Stafford, Esq., of counsel for defendant, and Wm. H. L. Lee, Esq., of counsel for complainant.

Mr. FREDERICK EMKIN, the defendant, produced as a witness, being duly sworn, deposes and says:

Q. 1. Please state your name, age, residence, and occupation.

47 A. Frederick Emken; age, 31 years; I reside at 322 East 58th street, New York city; I am a manufacturing chemist.

Q. 2. How long have you been engaged in the business of a manufacturing chemist?

A. About fourteen years.

Q. 3. Where and to what extent had you studied chemistry before you began manufacturing?

A. I have been studying chemistry in the High Real School, in Oldenburg, Germany; I have also studied chemistry, as apothecaries' apprentice, in Stade, Germany, and have passed there the examination as an apothecary.

Q. 4. Are you familiar with current chemical literature and works upon chemistry?

A. I am quite familiar with German, as well as English and French, works on chemistry.

Q. 5. Are you familiar with the method of manufacturing hydrogen peroxide described in chemical works and followed in its manufacture?

Objected to, so far as the question asks for what is described in chemical works, as not the best evidence; also objected to as irrelevant and immaterial.

A. Yes; I am.

Q. 6. Have you examined the process of manufacturing hydrogen peroxide described in the specification of complainant's patent?

A. Yes; I have.

Q. 7. Does the process there described differ in any essential particulars from the process described in chemical works older than complainant's patent?

Objected to as calling for secondary evidence.

Question withdrawn.

48 Q. 8. Does the process there described differ in any essential particular from the process of manufacturing hydrogen peroxide followed prior to the date of his patent?

Objected to as irrelevant and immaterial and because witness has not qualified as an expert to answer such question.

A. No; it does not.

Q. 9. What is the object, virtue, or necessity of stirring the liquid at all in the process of manufacturing hydrogen peroxide?

The same objection.

A. To bring the particles of barium peroxide into contact with the acid.

Q. 10. Has the stirring any other use or purpose than to bring the particles of barium into contact with the acid?

A. No; it has not.

Q. 11. What is necessary to cause the particles of barium and acid to act upon each other chemically so as to produce hydrogen peroxide?

A. That they be in contact.

Q. 12. Is anything else necessary to produce such chemical action?

A. No; nothing else.

Q. 13. Does anything else aid such chemical action?

A. At a given temperature nothing else will aid it.

Q. 14. Does mechanical motion of any kind or in any direction in itself cause or affect such chemical action in any way?

The same objection as to Q. 8 continued to all subsequent questions.

A. No; it does not.

49 Q. 15. Is such chemical action affected in any way by the direction of the motion caused by stirring the liquid in the process of manufacturing hydrogen peroxide?

A. No; it is not.

Q. 16. Is it the quality of hydrogen peroxide affected at all by the kind or direction of motion produced by stirring the liquid in the process of manufacturing it?

A. No; it is not.

Q. 17. What effect, if any, had the kind or direction of motion produced by stirring the liquid in the process of manufacturing hydrogen peroxide upon the yield or quantity from a given amount of ingredients?

A. It has none at all.

Q. 18. Does the use of the apparatus described in complainant's patent or the motion produced by that use have any chemical effect or influence whatever in manufacturing hydrogen peroxide?

A. It has no chemical influence beyond that of mixing the ingredients.

Q. 19. Mixing is not a chemical effect, is it?

A. No.

Q. 20. Does the complainant's apparatus serve any purpose except to bring the particles of the different ingredients in contact with each other?

A. No; it serves no other purpose.

Q. 21. Would the employment of the complainant's apparatus be equally beneficial in manufacturing any other chemical than hydrogen peroxide, in which stirring is necessary in the process of manufacture?

A. Yes, it would.

Q. 22. Have you used the apparatus now used by you in making hydrogen peroxide and described in Complainant's Exhibit "Sketch" for other purposes than making hydrogen peroxide?

A. Yes; I have.

Q. 23. For what else have you used it?

50 A. I have used it for mixing starch and water, in the manufacture of grape sugar, about eight years ago, and for about a year and a half.

Answer objected to as volunteered and as inadmissible under the pleadings, so far as it tends to show prior use or knowledge.

Q. 24. When did you first use your apparatus in making hydrogen peroxide?

The same objections as to last answer.

A. In December, 1882.

Q. 25. Prior to that time how had you stirred the mixture in making hydrogen peroxide?

The same objection.

A. I stirred it with a stick by hand.

Q. 26. Why did you not use a mechanical stirrer in manufacturing hydrogen peroxide prior to December, 1882?

A. Because I had no demand for a sufficiently large quantity of hydrogen peroxide to warrant the putting up of a mechanical stirring apparatus.

Q. 27. Does the amount of stirring necessary or desirable in making hydrogen peroxide vary according to the employment of different ingredients in making it?

The same objection as to Q. 8.

A. Yes; it varies greatly.

Q. 28. Give an illustration.

A. In using hydrated peroxide of barium in a fine state of division I require less stirring than in using more or less finely ground peroxide of barium. I also require very little stirring in using acids which form with barium a soluble salt in comparison to the amount of stirring necessary if I use an acid which forms with barium an insoluble salt.

51 Q. 29. How many revolutions per minute does your apparatus make as employed by you in the manufacture of hydrogen peroxide?

A. Twenty-five revolutions.

Q. 30. Can substantially the same kind of motion produced by complainant's apparatus be produced by stirring by hand?

The same objections as to Q. 8.

A. Yes; it can.

Q. 31. Do you know whether or not a screw has ever been employed in the manufacture of hydrogen peroxide or other chemicals?

The same objections as to Q. 24.

A. Yes; I know that a screw has been used as a stirrer in mixing marble dust in sulphuric acid.

Q. 32. How long ago?

The same objections.

A. I have seen such a screw used for this purpose about five years ago.

Q. 33. Where?

The same objection.

A. In the soda-water factory in 17th street.

Q. 34. Does the motion produced by your apparatus differ in any respect from the motion described in the specification of complainant's patent?

The same objections as to question 8.

A. Yes; it does.

Q. 35. State in what respect it differs.

A. It differs, firstly, in the rotation not being a continuous one, but being interrupted by the projecting counter-stirrer attached to the inside of the vessel; secondly, it differs on account of the
52 different shape of the stirring blades. The currents or motion produced by these blades are always in the direction of the tangents to the blades. The direction of the tangents to the stirring surface of my blades are all in a horizontal plane, and the currents produced by my blades are in a horizontal plane and describe circles the center of which is the revolving shaft. The tangents to the different parts of complainant's stirring blades are (the blades being spiral-shaped) not all in the horizontal plane, and the currents produced by these blades will be such as to cause a radial as well as an upward and downward propulsion.

Q. 36. Is there any rising and falling motion of the liquid caused by the revolving blades of your apparatus?

A. Yes; the liquid will rise on the inner walls of the vessel.

Q. 37. Is this motion due at all to the shape of the blades?

A. No; not as long as they cause a rotary motion.

Q. 38. Would the rising and falling motion which you describe occur if the stirring were done by hand with a stick?

The same objections as to question 8.

A. Yes; it would.

Q. 39. If the stirring be done by hand would you get as good results in point of yield and in point of time occupied in the process as if the stirring were done by mechanical apparatus?

The same objection.

A. Yes; I would.

Q. 40. State any practical tests in these respects that you know of.

A. We have stirred the ordinary quantity of hydrogen peroxide which we make in one operation four or five times by hand
53 when our machinery was out of order. We have at no time in these instances noticed a decrease of yield in the regularly performed testing of the product.

Q. 41. How as to the time taken?

A. The time necessary for the operation was the same.

Q. 42. How as to the time actually taken in the manufacture by the two different processes—the one by hand and the other by the mechanical apparatus?

A. The time taken was the same.

Q. 43. What is the advantage of a mechanical stirring apparatus over hand stirring in the manufacture of hydrogen peroxide?

A. The saving of labor.

Q. 44. Is there any other advantage over hand stirring in the use either of your apparatus or the apparatus described in complainant's patent?

A. No; there is none.

Q. 45. Has there at any time been a sudden large increase in the use and demand for hydrogen peroxide?

A. Yes; the consumption started on a larger scale in about the year 1880, and has since been increasing.

Q. 46. Do you know what caused that increase in the consumption of hydrogen peroxide?

A. The fact that it became known amongst the parties interested.

Q. 47. Was it about the period you mention used for the first time in certain industries?

Objected to as leading and as incompetent, the witness not having the knowledge necessary to qualify him as an expert.

Question withdrawn.

Q. 48. Do you know for what hydrogen peroxide was chiefly used prior to the date you mention?

A. For bleaching hair.

54 Q. 49. In what has it been chiefly used since the date you mentioned?

A. For bleaching feathers, silk, and ivory.

Q. 50. How long have you been engaged in the manufacture of chemicals on your own account?

A. Since 1875.

Q. 51. Prior to that time what had been your practical experience in such manufacture?

A. I have been engaged for three years in making chemical preparations in Stade, Germany. I have been engaged in New York city for about six months in the chemical laboratory of McKesson & Robbins. I have been the scientific editor of the American Beer Brewer, published in this city, for about a year.

Q. 51½. At what places has your laboratory or factory been since you have been a manufacturer of chemicals on your own account?

A. In Centre street, New York; Clifton, Staten Island, and Sixtieth street, New York city.

Q. 52. How long at each place—giving the dates as near as you can?

A. In Centre street, about six months; in Clifton, about two years, and in Sixtieth street, since about six years.

Q. 53. State your studies and experience in mechanics.

A. I have studied dynamics in Oldenburg, Germany, for about three years, in connection with chemistry and the other exact sciences.

Defendant's counsel offers in evidence letters patent of the United States issued to Frederick P. Deual, dated March 23d, 1869, and No. 88016, and the same is marked Defendant's Exhibit 1, August 1, 1884, J. A. S., ex'r.

Also letters patent of the United States issued to Charles
55 Lehmann, dated September 10, 1882, No. 131,283, and the same is marked Defendant's Exhibit 2, August 1, 1884, J. A. S., ex'r.

Also letters patent of the United States issued to William Brower, dated July 14, 1874, No. 152,895, and the same is marked Defendant's Exhibit 3, August 1, 1884, J. A. S., ex'r.

Also letters patent of the United States issued to George Mooney

June 3, 1879, No. 216,053, and the same is marked Defendant's Exhibit 4, August 1, 1884, J. A. S., ex'r.

Also letters patent of the United States issued to Joseph Teherniac and Ury Gunzburg, dated December 9, 1879, No. 222,547, and the same is marked Defendant's Exhibit 5, August 1, 1884, J. A. S., ex'r.

Also letters patent of the United States issued to T. R. Markillie, dated August 27, 1861, No. 33154, and the same is marked Defendant's Exhibit 6, August 1, 1884, J. A. S., ex'r.

Adjourned to Monday, August 4, 1884, at 10.30 a. m.

NEW YORK, *August* 4, 1884—10.30 a. m.

Met pursuant to adjournment.

Present: Counsel as before.

Examination of Mr. FREDERICK EMKEN continued:

Q. 54. Have you read over your testimony as written down?

A. I have.

56 Q. 55. Do you find in it anything that you wish to alter?

A. Yes; in answer to Q. 35 I want to have the word "tangent" replaced by "the perpendicular line erected on the stirring surface of the blade."

Cross-examined by Mr. LEE:

X Q. 56. What is the chemical formula of binoxide of barium?

A. $Ba\ O_2$.

X Q. 57. What is the chemical formula for peroxide of hydrogen?

A. $H_2\ O_2$.

X Q. 58. That means, does it not, that there are two portions of hydrogen to two portions of oxygen?

A. I can't answer that, because I don't know what you mean by portions.

X Q. 59. Explain what it does mean.

A. It means a combination of hydrogen and oxygen in which two atoms of hydrogen and two atoms of oxygen form one molecule.

X Q. 60. Peroxide of hydrogen is a chemical combination as distinguished from a mixture, is it not?

A. Yes.

X Q. 61. The hydrogen is entirely obtained by decomposition of the acid, is it not, with which the binoxide of barium is brought into contact?

Objected to as not being cross-examination of the witness, and defendant's counsel gives notice that the answer to the question will be treated as the complainant's testimony.

A. It may be obtained from the acid, but later researches as to the formation of peroxide of hydrogen show this formation to be more likely a process of reduction of the water molecule.

57 X Q. 62. Explain what you mean by "a process of reduction of the water molecule."

Same objection and notice as to last question.

A. The eliminating of two atoms of hydrogen out of a double molecule of water.

X Q. 63. How is the molecule of water first obtained in this process?

Same objection and notice.

A. I have reference to the water that is present in the reaction.

X Q. 64. What I wish to know is how the water is obtained from the two substances which are brought into contact, one being binoxide of barium and the other being some acid.

A. If the contact of acid and barium takes place in the presence of water there is no water formed in the reaction.

X Q. 65. Under the most favorable conditions how long does it take to complete the chemical reaction which results in the formation of peroxide of hydrogen when, say, 25 gallons of the mixture are brought together?

A. The reaction is immediate in case of contact. The duration of the operation of making 25 gallons of peroxide of hydrogen depends largely on the relative fineness of the barium or its relative state of division, and on the kind of acid used, whether it be one that forms a soluble barium salt or one that forms an insoluble barium salt. Therefore, without naming the method of making in detail of peroxide of hydrogen I could not say how long it would take to make 25 gallons.

Answer objected to as irresponsive.

X Q. 66. X Q. 65 repeated.

58 A. It does not take any time to complete a reaction, but it might take an hour to complete an operation.

X Q. 67. What is the shortest time that you have ever occupied in making that quantity of peroxide of hydrogen?

A. One hour.

X Q. 68. You say that the duration of the operation depends largely on the fineness of the barium and the kind of acid if the reaction is immediate. Will you please explain how this is?

A. The reason for the fact that the operation is shorter if I use a more finely ground barium or an acid that forms a soluble salt is that the contact in these instances is more readily produced.

X Q. 69. Why is the contact more readily produced with one kind of acid than with another?

A. In the case of using an acid that forms an insoluble salt the insoluble salt is apt to hinder the contact by attaching itself to the barium peroxide.

X Q. 70. What is the specific gravity of peroxide of hydrogen as compared with water?

A. Peroxide of hydrogen free from water, which seldom, if ever, has been made, is said to have a specific gravity of 1.3, I believe.

X Q. 71. What you mean by the first part of your last answer is this, is it not, that hydrogen peroxide as it is made is, as a general rule, mixed with water?

A. Yes.

X Q. 72. Hydrogen peroxide is a liquid, is it not?

A. Yes, sir.

X Q. 73. And when you say it is mixed with water you mean that it is a mechanical mixture and not a chemical combination?

A. I mean it is a mixture and not a chemical combination.

X Q. 74. Supposing the theory to be correct that peroxide of hydrogen is formed by a reduction of the water atoms, please state how such reduction is caused and with what the particles of
59 hydrogen which are freed from the atoms of water unite, and what is the result.

A. The atoms of hydrogen of the water molecules combine with the atoms of the molecule of peroxide of barium and form peroxide of hydrogen. The water molecules do not undergo the reduction but the barium molecules. In my answer to cross-question 61 I meant to say that the process of the formation of peroxide of hydrogen is, according to late researches, a process of reduction as against the former theory of being a process of oxidation. It is the barium molecule which undergoes a reduction by the water molecules.

X Q. 75. Then does the water which is in the mixture remain entirely unchanged while the process of forming hydrogen peroxide is going on?

A. According to these late researches that I referred to it does not.

X Q. 76. How recently have these researches come to your knowledge?

A. Within a year.

X Q. 77. Sulphuric acid is one of the acids that can be used to form hydrogen peroxide, is it not?

A. Yes.

X Q. 78. Now, suppose that hydrogen peroxide is made by using the proper quantity of sulphuric acid, water, and binoxide of barium. Please give the chemical formula for each of these substances, the reactions and combinations that take place in each, and the results that take place after the process of making hydrogen peroxide is completed, giving in each case the chemical formula.

A. The chemical formula of sulphuric acid is $S O_4 H_2$; of barium peroxide, $Ba O_2$; of water is $H_2 O$. While reacting on each other the Ba combines with $S O_4$ to sulphate of barium, the H_2 may in part combine with O_2 and in part combine with O of the water molecule. The result of the latter complex reaction is $H_2 O_2$ or peroxide of hydrogen and $H O_2$ or water.

X Q. 79. Then, in making hydrogen peroxide, the reaction
60 is hastened, is it not, by bringing fresh particles of water in contact with fresh particles of acid?

A. No; I cannot say that it is hastened, because the contact is conditional to the reaction. It is not promotion of the reaction, but a bringing into contact is a necessity for the reaction.

X Q. 80. If your answer to X Q. 78 was correct why can you not make hydrogen peroxide by combining sulphuric acid and water?

A. It does not follow out of my answer that I could.

X Q. 81. X Q. 80 repeated.

A. I do not see the connection between my answer to X Q. 78 and the last question.

X Q. 82. You say in answer to X Q. 78 that the H 2 may in part combine with the O of the water molecule, the result of the latter complex reaction being $H_2 O_2$ and $H_2 O$. With this explanation X Q 80 is repeated.

A. Because the H_2 of the molecule $S O_4 H_2$ is not liberated in the case of mixing sulphuric acid and water.

X Q. 83. Then it is necessary, is it not, that the acid should come in contact with the binoxide of barium in order to allow any of the chemical reactions to occur which you describe in your answer to X Q. 78?

A. Certainly.

X Q. 84. What is the specific gravity of sulphuric acid?

A. The specific gravity of the so-ealled monohydrated sulphuric acid is 1.75 or near to it. The fuming sulphuric acid has a greater specific gravity, near 2.

X Q. 85. How near 2? In answering this question answer only as to what is within your positive knowledge.

A. The statement of the specific gravity of fuming sulphuric acid is 2 and allowing 25 per cent. as a possible error.

61 X Q. 86. Then, in order that all the chemical reactions referred to in your answer to X Q. 78 should take place, it is necessary, is it not, first, that the sulphuric acid should come in contact with the binoxide of barium; then that the water should either come in contact with the sulphuric acid, or in any event that it should come in contact with the H 2 of the sulphuric acid?

A. Yes; it is necessary that the bodies in question should be in contact in order to react upon each other.

X Q. 87. Then whatever will serve to make the contact more expeditious will serve to shorten the operation of making hydrogen peroxide, will it not?

A. Although I do not know what is meant by making the contact more expeditious, I will say that, if other conditions be the same, the amount of the molecules in contact with each other is a measure of the expeditiousness of the operation.

X Q. 88. That is, as I understand it, the more fresh molecules of binoxide of barium, sulphuric acid, and water that are brought in contact the greater are the opportunities for the reactions to occur?

A. I do not know what fresh molecules of barium are, and refer to my last answer.

X Q. 89. That is, as I understand it, the more molecules of binoxide of barium, sulphuric acid, and water that are brought in contact the greater the opportunities for the reactions to occur?

A. Yes; the more contact the more reaction.

X Q. 90. Whose researches are those which you refer to on this

subject and which you say have come to your knowledge within a year past?

A. The researches of Dr. M. Traube.

X Q. 91. Where were such researches made and where is an account of them published?

A. They were made at Breslau and published in the reports of the Deutschen Chemischen Gesellschaft.

62 X Q. 92. Was it not the generally accepted opinion prior to these researches that no chemical reaction occurred in the water? And, if not, state what reactions were supposed to take place in the manufacture of peroxide of hydrogen.

Same objection and notice as to X Q. 61.

A. Yes; it was.

X Q. 93. Is not that opinion still held by many chemists?

Same objection and notice, and further objected to as irrelevant and immaterial.

A. I don't know.

X Q. 94. What is the specific gravity of binoxide of barium?

A. I suppose about 3.

X Q. 95. What is the capacity of the vessels which you use in making hydrogen peroxide?

A. About 100 gallons.

X Q. 96. Are they all of the same size?

A. Yes; we only have one.

X Q. 97. How much hydrogen peroxide can you make at a time?

A. About 80 gallons.

X Q. 98. When you first began to make hydrogen peroxide, in 1880, what price did you charge for it?

A. We did not make it in 1880.

X Q. 99. When did you begin to make it by hand?

A. I have neither made peroxide of hydrogen or any other chemical by hand. Such an expression is not admissible in speaking of the manufacture of chemicals.

Counsel for complainant desires to warn the witness that it is his duty to answer the questions put to him to the best of his
63 ability, and it is not his province either to criticize their form or to quibble in answering them.

Defendant's counsel states to the witness that his answer, if true, is perfectly proper.

X Q. 100. X Q. 99 repeated.

A. I never made it by hand.

X Q. 101. Do you mean to say that you do not understand that the last two questions referred to what you state in question 25, where you were asked how, prior to a certain time in the question referred to, you had stirred the mixture, and you answered, "I stirred it with a stick by hand?"

A. I knew that you referred to it, but the making of a chemical

does not consist in stirring a mixture; therefore I said I had not made it by hand.

X Q. 102. Did you, at the time that X Q's 99 and 100 were asked, have the least doubt as to the inquiry that was intended to be made by the question?

A. I had no doubt as to the intention of the question, but believed that my answer should be in conformity with the question, and not in conformity with the intentions which are not expressed in the question.

X Q. 103. Now, as you understand the intention of the question, I repeat X Q. 99, and require you to answer it according to the intention of the question as you say it is known to you, making whatever qualifications in your answer you please.

Defendant's counsel instructs the witness that he is perfectly correct in his view that his answer should be to the question as put in its ordinary meaning as read, and without any regard to the intention as to the meaning which may have been in the ques-
64 tioner's mind, but that if he chooses to give an answer which will save time he may do so, qualifying his answer in such way that he will not be tripped up by the question.

A. I made it eight years ago in small quantities of about a pound at a time, and in using a glass rod for the slight agitation of the mixture that was necessary.

X Q. 104. You have stated that the consumption of hydrogen peroxide started on a larger scale in or about the year 1880. How did you make hydrogen peroxide during 1880, 1881, and 1882, during that portion of the year before you began to stir by machinery?

A. I have not made any peroxide of hydrogen at all during that period.

X Q. 105. Did you make any during the year 1879?

A. No.

X Q. 106. Did you make any during the year 1878?

A. No.

X Q. 107. Did you make any during the year 1877?

A. No.

X Q. 108. Did you make any during the year 1876?

A. I believe it was that year in which I made a small quantity; less than a pound.

X Q. 109. And you did not make it then by stirring it with a stick?

A. No; I used a glass rod.

X Q. 110. Why did you then say, in answer to Q. 25, that prior to December, 1882, you stirred the mixture with a stick by hand; and why did you also state, in answer to Q. 26, that you did not use a mechanical stirrer prior to December, 1882, because you "had no demand for a sufficiently large quantity of hydrogen peroxide to warrant the putting up of a mechanical stirring apparatus?'

65 A. I believe it was the year 1875 when I used a stick to stir it instead of a glass rod. My answer as to stirring with the stick refers to that incident.

X Q. 111. Where did you make it in 1875 and stir with a stick, and in what quantities at a time?

A. In Staten Island. I made it in the kitchen of our private house, in Stapleton, S. I. I made about a pound at a time.

X Q. 112. Was the kitchen of your private house your laboratory that has been referred to in the previous part of your examination as being at Clifton, S. I.?

A. No; the house was at Stapleton and the laboratory at Clifton.

X Q. 113. Prior to 1875 had you made hydrogen peroxide?

A. No, sir.

X Q. 114. For what purpose was the hydrogen peroxide that you made in 1875 and 1876 made?

A. It was made with the intention of bleaching negroes.

X Q. 115. Did you ever use this hydrogen peroxide that you made at that time for any practical purpose?

A. No; I did not. I made it out of curiosity.

X Q. 116. You have spoken of having made hydrogen peroxide by hand since you began to use a mechanical stirrer. I refer particularly to Q's 39 to 43. Please state how you came to do the stirring by hand on these occasions, and how many such occasions there were.

A. We have stirred by hand since that time, and during a period of about eighteen months for about four, five, or six times when some part of the machinery was out of order. The machinery being out of order consisted in the engine undergoing repair or the belts refusing their service.

X Q. 117. When was the first occasion when you did the stirring by hand since you have been in the business, and how much hydrogen peroxide did you make at that time?

66 A. It was during the first months of making peroxide of hydrogen, and we made, I believe, fifty or sixty gallons of it at that time.

X Q. 118. Who did the stirring?

A. One of our workingmen engaged in the manufacture of peroxide of hydrogen.

X Q. 119. What was his name?

A. I don't know which particular one did the stirring of three or four men engaged in that manufacture.

X Q. 120. Give the names of all the three men who were engaged in that manufacture at the time referred to.

A. Wm. Hahn, Hans Focke, and John Brane.

X Q. 121. Are any of these men with you now?

A. Yes.

X Q. 122. Which ones?

A. All three.

X Q. 123. Did you personally measure the amount of the various ingredients that were used on this occasion?

A. No; I did not.

X Q. 124. How much hydrogen peroxide was made on this occasion at one operation?

A. Fifty to sixty gallons.

X Q. 125. Did you personally measure the amount?

A. No; but I supervised the product turned out and the material used for it.

X Q. 126. During what part of the operation were you present?

A. I was present during the whole time of bringing barium and acid together and during the time when it was tested for its strength, as I have been during every operation during the first month of making peroxide of hydrogen.

X Q. 127. At what time of the day was this operation begun?

A. At that time we began every operation between twelve and one in the afternoon.

67 X Q. 128. Did you begin the operation on the occasion referred to between 12 and 1 in the afternoon?

A. I have no doubt that I did.

X Q. 129. Are you willing to swear positively that you did?

A. I am not positive as to the hour of the day.

X Q. 130. Was there more than one man stirring at a time on this occasion?

A. I believe not, as it only requires slight agitation.

X Q. 131. Are you willing to swear positively that there was only one man at a time stirring on this occasion?

A. No; I will not.

X Q. 132. Did the men relieve each other in the stirring, or were the same men or man stirring during the entire operation?

A. I believe that they relieved each other.

X Q. 133. At what hour in the day was the operation concluded?

A. Two hours after the commencement of the operation.

X Q. 134. Are you positive that the operation was completed on this occasion within two hours?

A. I am positive that it was completed in the usual time, which is about two hours.

X Q. 135. How does your memory come to be so exact on this point?

A. Because it would have struck me as strange if it had taken any longer than the ordinary time, and I would have remembered it.

X Q. 136. Did you take any note of the hour of the day when this operation was completed on this occasion?

A. I did not take any more note of the time than I took of any other occasion.

X Q. 137. Then when you say it took the same time, on the occasion referred to, that it ordinarily did, it is a mere matter of estimate and guess-work, is it not?

68 A. No; when I say it took the same time I meant practically the same time, as a quarter of an hour, more or less, is of no practical consequence, and as we have no exact standard of that time fixed which is necessary for the operation under ordinary circumstances.

X Q. 138. As I understand it, on this occasion you were present while the operation was being performed, and without timing the operation you are of the opinion that it took about the same time that it took when the stirring was done by machinery, or, if it took

any more, the amount of additional time it took was of no practical consequence; am I right?

A. Not exactly, because a clock was and is standing opposite the tub in which the peroxide was made, and it was my habit to often look at the clock in the latter part of the afternoon, as I lived in Hoboken, and was in a hurry to get home.

X Q. 139. What was your ordinary hour of going home?

A. Five o'clock.

X Q. 140. Have you any distinct recollection of having looked at the clock on the afternoon in question at the time of the completion of the operation? And, if so, state what the hour was when the operation was completed.

A. I have no distinct recollection of my looking at the clock on that day and at the time of the finishing of the operation, but I have no doubt that I did.

X Q. 141. Well, then, to repeat the substance of X Q. 138, as I understand it, you were present on the occasion referred to while the operation was being performed, and without timing it you are of the opinion that it took about the same time as when the stirring was done by machinery, or, if it took any more, the additional time was of no practical consequence; that there was a clock before you which you could have looked at if you wanted to, and that you think you did without being positive; is that right?

69 A. No; there was no batch of peroxide of hydrogen made without timing it.

X Q. 142. What was the time on this particular occasion?

A. The same as usual.

X Q. 143. I wish the time in hours and minutes, and the time when you began and the time when you finished.

A. About two hours; the time of the day when I begun and finished I do not remember.

X Q. 144. How do you know it was about two hours?

A. Because it would have struck me as strange if it had taken essentially more or less.

X Q. 145. If you have any knowledge of the time it took to complete the operation on this occasion please mention fully and at large; confine yourself to knowledge and not guess-work.

A. It took about two hours.

X Q. 146. X Q. 145 repeated.

A. I have no other knowledge of this incident but what I have stated, and not the details of that operation but its result has become impressed on my mind.

X Q. 147. State in what condition the binoxide of barium was that you used on this occasion?

A. We did not use binoxide of barium, but the hydrate of the peroxide of barium.

X Q. 148. What is the difference between the two?

A. The one contains the elements of water in its molecules and the other not.

X Q. 149. What was the condition of the barium, as to its state of division, on this occasion?

A. The hydrated peroxide of barium when mixed with water, as we used it, is in the highest state of division attainable in solid bodies.

X Q. 150. Were the acid or acids which you used on this occasion acids which formed with barium a soluble salt?

70 A. One of them formed a soluble salt and the other formed an insoluble salt.

X Q. 151. Now, you have stated that since you began to stir with machinery you have four or five or six times made your hydrogen peroxide, the stirring being done by hand. Can you give any of the details in regard to any one or more of the operations which were performed on these occasions with any greater exactness or certainty than you have already given as to the first? And, if you can, please do so, and state the grounds of your knowledge.

A. I have only been present during two of such operations; during the latter of these two the liquid was in the first half of the period stirred by machinery; during the other times I rely on our foreman for a statement as to the liquid being stirred by hand, and rely on his written report as to the yield of each operation, which report is made weekly of every operation.

All of the answer except the first sentence objected to as not the best evidence, and a motion will be made to strike out the same.

X Q. 152. To whom was the hydrogen peroxide delivered that you made by hand on the first of the occasions referred to?

A. I don't know.

X Q. 153. So far as the action upon the barium and the water is concerned, the same chemical changes occur in making peroxide of hydrogen when sulphuric acid is used as occur when other acids are used which are capable of being used in this manufacture; is not this so?

A. Yes; the chemical action of these acids is the same.

X Q. 154. Of what concentration was the peroxide of hydrogen that was made on the first occasion when you did the stirring by hand after you begun to do the stirring by machinery?

71 A. It contained 3½ per cent. of peroxide of hydrogen.

X Q. 155. How do you know this?

A. I know it from the fact that all our peroxide of hydrogen which we made at that time proved to have this strength.

X Q. 156. Did you test the product of this particular operation?

A. I tested the product of every operation at that time.

X Q. 157. Have you any recollection as to the strength of the product of that particular operation other than arises from the fact that that was the usual strength at that time?

A. I have no other recollection but that the strength was the usual one and that it corresponded to 3½ per cent. of peroxide of hydrogen, and that the usual strength corresponded to 3½ per cent. of peroxide of hydrogen.

X Q. 158. What were the form, shape, and size of the stirrer that you used when you stirred by hand on the occasion inquired of?

A. It was an ordinary pestle-shaped piece of wood, being about four inches wider at one end and round or cylindrical at the other.

Redirect:

R. D. Q. 159. Do you know positively that you made or was present and saw made a test of the strength of the peroxide of hydrogen upon the occasion that has been inquired about, when the stirring was done by hand?

A. Yes; I am positive I was present when the test was made.

R. D. Q. 160. And that the result was 3½ per cent.?

Objected to as already answered.

A. Yes; I am positive of that.

72 R. D. Q. 161. Does the time occupied in the process when the stirring is done by machinery vary a quarter of an hour, more or less, in making the same quantity?

Objected to, as it already appears that the witness has no knowledge on the subject, and any answer he may give would be the merest guess-work.

A. Yes; it does.

R. D. Q. 162. Have you frequently been present and assisting in the manufacture when the stirring has been done by machinery?

A. Yes; hundreds of times.

R. D. Q. 163. Is your answer as to variation of time based upon your own personal knowledge and experience?

Objected to, as it appears that the witness has no knowledge on the subject.

A. Yes; it is.

FREDERICK EMKEN.

Sworn before me—

JOHN A. SHIELDS, *Examiner.*

Adjourned to Monday, September 15th, 1884, at 2 p. m., and defendant's time to take testimony is extended to and including Sept. 20th, 1884, and complainant's time for taking testimony in rebuttal is extended to and including October 20th, 1884, and either may notice the cause for the October term.

73 U. S. Circuit Court, Southern District of New York. In Equity.

CHARLES MARCHAND *vs.* FREDERICK EMKEN.

NEW YORK, *November* 8, 1884.

Testimony taken on behalf of the complainant, in rebuttal, before John A. Shields, Esq., examiner.

Present: W. H. L. Lee, Esq., for complainant; M. P. Stafford, Esq., for defendant.

CHARLES MARCHAND, being produced and sworn as a witness for complainant, says:

Q. 1. Have you been heretofore examined as a witness in this suit?

A. Yes, sir.

Q. 2. When did you begin to manufacture hydrogen peroxide?

Objected to as not being evidence in rebuttal nor in reply to anything called out by the evidence for the defence.

A. In 1879, in December.

Q. 3. Who, as far as you know, was the first person to manufacture hydrogen peroxide in the United States?

Same objection, with the additional objection that it is irrelevant and immaterial.

A. I was; I mean industrially, on a large scale.

74 Q. 4. At that time for what purposes was it used in the arts?

Same objection as to question 2.

A. It was used for the purpose of bleaching hair and for medicinal purposes, and I was making some trials to apply it to the bleaching of ostrich feathers.

Q. 5. Was it at that time—December, 1879—used generally for bleaching ostrich feathers?

Same objection as to last.

A. No.

Q. 6. As to its use for medicinal purposes, in what quantities was it so used?

Same objection.

A. In small quantities.

Q. 7. As to the bleaching of ostrich feathers, what was the result of the experiments of which you have spoken?

Objected to on the same ground as objection to question No. 2; also on the ground that it is irrelevant and immaterial.

A. The result of the experiment was that I succeeded after a few weeks of experimenting to bleach feathers.

Q. 8. When did you so succeed?

Same objection as to last preceding question.

A. In March or April—the end of March, 1880.

Q. 9. State whether or not you ever sent out any circulars to the feather trade in regard to bleaching feathers by the use of hydrogen peroxide.

Objected to on the same ground as to the last preceding question.

75 A. Yes, sir; I did.

Q. 10. When?

Same objection.

A. In June, 1880.

Q. 11. Can you produce one of those circulars?

A. I don't know if I have any left. I can produce many witnesses that have received those circulars.

Q. 12. What was the purport of such circular?

Objected to on all the grounds raised to any of the preceding questions, and on the further ground that it calls for the contents of a paper when the paper itself should be produced as the best evidence.

Counsel for complainant requests that the objection founded on the failure to produce the paper itself be waived, provided the complainant shall hereafter produce either a copy of the circular itself or give competent proof that none can be found.

Defendant's counsel grants this request.

A. It was to call the attention of the feather trade to the application of hydrogen peroxide to the bleaching of feathers and to invite them to call at my place to receive the explanation of the process.

Q. 13. Did this circular have any effect in introducing the use of hydrogen peroxide for bleaching feathers?

Objected to as not proper rebuttal testimony and as not being called out by any of the defendant's testimony, and on the further ground that it is irrelevant, immaterial, and incompetent, and
76 on the further ground that it calls for a speculative opinion instead of a statement of facts.

A. Yes, sir; the feather manufacturers called at my place to enquire about the process. Some of them gave me some gray or black natural feathers to bleach as a sample, which I did; then I gave them the explanation of the process.

Q. 14. Since you began to make hydrogen peroxide have other articles besides hair and feathers been bleached by using it? And, if so, state some of them.

Objected to as not proper rebuttal testimony and as incompetent, irrelevant, and immaterial, and as calling for a conclusion.

A. Yes, sir; Tussah silk, ivory, bones, wool, horsehair, bristles; there may be some others; that is what I know.

Q. 15. Prior to the time that you began to make hydrogen peroxide was it known that some of these articles could be bleached by hydrogen peroxide?

A. Yes, sir.

Q. 16. Why was it not so used?

Objected to on the same ground as the last preceding objection to question 14.

A. Because it was too expensive.

Q. 17. Before you began the manufacture of this article where was it made and how was it obtained in this country?

Last previous objection repeated.

A. It was manufactured, as far as I know, in France, in Germany, and in England. It was obtained in this country by importing.

77 Q. 18. Please state whether or not your business was such that if it had been made in this country before you began to make it that you would have known of it.

A. Yes, sir; I think I would have known of it.

Q. 19. State whether or not you have any doubt that you would have known of it.

A. I have no doubt at all.

Q. 20. Just prior to the time when you began to make it, please state at what price it was sold in the market in this country.

Objected to as not proper in rebuttal testimony and as being irrelevant and immaterial.

A. It was sold at that time at $9.60 per gallon. It was sold in bottles holding five pints at $6.

Q. 21. When you began to make it at what price did you sell it?

Same objection as last.

A. At $8 per gallon.

Q. 22. About how much did you sell the first month?

Same objection as the last repeated.

A. About 100 gallons.

Q. 23. And at first were your sales confined to any particular trade?

A. Yes; it was confined to the hair trade.

Q. 24. Until about what time was it so confined to the hair trade?

Same objection as last repeated.

A. About March, 1880.

Q. 25. When did you first change your price from $8 per gallon?

Same objection.

78 A. It was in June or July, 1880.

Q. 26. How could you afford to make this change?

Same objections.

A. Because the demand was increasing.

Q. 27. After you sent out your circulars, state whether or not the demand increased; and, if so, at what rate.

Objected to on the same grounds last specifically stated; also on the ground that it is speculative instead of calling for facts, and calls for a conclusion.

A. After I sent out the circulars the demand increased largely; I sold about four or five times more in one month.

Q. 28. After this rapid increase in the demand were you able to supply the demand with facility?

Objected to as not proper rebuttal evidence and as being irrelevant and immaterial.

A. No; I was very hard pushed.

Q. 29. What did you do to enable you to supply the demand more readily?

The last preceding objection repeated.

A. I made experiments to replace the manufacturing by hand by mechanical arrangement.

Q. 30. When did you begin to make such experiments?

Same objection as last.

A. I began the last part of 1880.

Q. 31. Prior to that time you had been making it by hand, had you not?

Same objection as last.

79 A. Yes.

Q. 32. Did you at once adopt the method of manufacture and the devices described in your patent in suit?

Same objections.

A. No, sir.

Q. 33. State the successive steps from the time you first began to experiment to the time you reached the result shown in your patent.

Same objections.

A. At first the arrangement which I used was a kettle with a round bottom, in the axis of which was revolving a vertical board, 9 inches wide, about, by eighteen inches high, that board being fixed on the vertical shaft, which was put in rotary motion by machinery.

Q. 34. Please produce a sketch of the same and explain it.

Same objection.

A. I produce the sketch of the same. A is the kettle, B is the vertical shaft, and C is the board. The motion was given to the shaft by ordinary mechanical arrangements.

Sketch referred to offered in evidence and marked "Complainant's Exhibit Sketch B, November 8, 1884, J. A. S., ex'r."

Last objections repeated to the introduction of the sketch.

Q. 35. State whether or not this effected any improvement or saving of labor over the old method of making by hand.

Same objection.

80 A. Yes; it did. It was an improvement, and it saved labor.

Q. 36. Apart from its saving of labor, why was it an improvement?

Same objection.

A. In mixing up more thoroughly the chemicals which were put in contact, and in making more regular the chemical reaction.

Q. 37. Was it entirely satisfactory?

Same objection.

A. No; it was quite imperfect.

Q. 38. Why was it imperfect?

Same objection.

A. Because the movement of the mixture was not entirely proper for that purpose, because of the heavy weight of the binoxide of barium which settles at the botton so quick that it was not brought constantly in contact with the new particles of acid solution.

Q. 39. Did you use this apparatus practically; and, if so, for how long?

Same objection.

A. Yes, sir; I did, for about six weeks or two months.

Adjourned to Tuesday, 11th November, 1884, at 3½ p. m.

NEW YORK, *Nov. 11th*, 1884.

Met pursuant to adjournment.

Present: Counsel as before.

Counsel for complainant offers in evidence a certified copy
81 of the letters patent granted to Charles Marchand, dated March 6, 1883, No. 273,569, together with certificate that the application for the same was filed complete August 2, 1882, and the same is marked "Complainant's Exhibit B, November 11, 1884, J. A. S., examiner."

Q. 40. Explain what movement was imparted to the fluid and what to the solid portion of the contents of the kettle, and state why the result was imperfect.

Same objection.

A. The fluid part of the mixture received a rotary movement and the solid part received also a rotary movement, but the difference between the specific gravity of the fluid part and the solid is so great that one portion of the binoxide of barium will settle at the bottom of the kettle, and consequently it will cease to be brought in contact with new particles of the acid solution.

Q. 41. Please produce a sketch showing the position of the barium and of the liquid in the kettle while the blade is revolving.

A. I produce the sketch.

Sketch offered in evidence and marked "Complainant's Exhibit Sketch C, Nov. 11, 1882, J. A. S., examiner."

Q. 42. Explain what the black mass in such sketch is, which is marked B, and what the line marked C is.

A. The black mass which is marked B represents the binoxide of barium which has settled on the bottom of the kettle, and the line marked C represents the curved surface of the liquid while the blade is in motion.

Q. 43. Explain why the reaction is imperfect.

A. The reaction is imperfect because the portion of binox-
82 ide of barium which settles at the bottom of the kettle ceases to be brought in contact with the new particles of acid solution, and consequently the reaction is partly stopped during the time it remains at the bottom.

Q. 44. What is the movement of the particles of the fluid which are at the top, at or near the line C?

A. It is a rotary movement. The particles go round and round and the solid part of the mixture goes round and round also, but the great weight of the solid particles relatively to the specific gravity of the acid solution is such that they tend to fall down continuously, because there is not any movement in the mass to prevent its falling to the bottom.

Same objections are to be considered as made to all the questions already asked and those to be asked on this line of examination.

Q. 45. Is there anything which tends to cause the particles of the fluid which are at or near the surface C to fall to a lower level?

A. Yes; the centrifugal force which tends to form that curve.

Q. 46. What did you do to prevent the accumulation of binoxide of barium at the bottom?

A. A boy with a stick goes around the kettle and stirs it up at short intervals from time to time.

Q. 47. When the mass of binoxide of barium at the bottom was stirred what was the result?

A. The result was a loss of oxygen gas, because at the very moment when the stick removes the settlement of binoxide of barium this binoxide of barium is suddenly brought in contact with an insufficient quantity of acid solution to allow the oxygen gas to combine with hydrogen to form peroxide of hydrogen, and the result is that the greatest portion of the oxygen escapes and that constitutes a loss.

83 Q. 48. What was your next experiment?

A. My next experiment consisted in stirring the mixture with a board attached to a shaft, which received a rotary movement, the board being about five inches high by about fifteen inches long. The board itself was from a half to a quarter of an inch from the bottom. The shaft rested on the bottom.

Q. 49. How did the result compare with the result produced by the first device?

A. The result was not so bad as it was with my first experiment, although it did not give me the result which I expected.

Q. 50. Look upon the sketch that I now show you and state what it is.

A. The sketch represents the mechanical arrangement with which I conducted my second experiment. B represents the vertical shaft resting on the bottom of the kettle, and at its lower end is fixed the blade C. A represents the tub.

Sketch referred to offered in evidence and marked "Complainant's Exhibit Sketch D."

Q. 51. The tub A in this sketch does not appear to be curved at the bottom. Is this correct?

A. Yes; it is correct.

Q. 52. What apparatus did you next use?

A. My third experiment consisted of a kettle with a round bottom, in the axis of which a shaft received a rotary movement. This shaft bears at its lower part three horizontal vertical blades; each one was about 4 to 5 inches high by 8 inches long.

Q. 53. Look upon the sketches which I now show you and state what they are.

A. The upper sketch represents the vertical section of the apparatus I used in my third experiment. A represents the kettle, B represents the vertical shaft, and C C C represents the three blades. The lower sketch represents the horizontal section of the same apparatus. Similar letters refer to similar parts.

84 Sketch offered in evidence, marked "Complainant's Exhibit Sketch E, Nov. 11, 1884, J. A. S., examiner."

Q. 54. Were the wings all on the same horizontal plane?

A. Yes.

Q. 55. Did the shaft B touch the bottom of the kettle A?

A. No.

Q. 56. What result was obtained by the use of this device?

A. The result was very good, as the motion of the mass was very appropriate.

Q. 57. When did you first begin to use this?

A. In the last part of March, 1881.

Q. 58. State what change, if any, you have made in your apparatus since.

A. Instead of employing three vertical blades I gave the preference to four blades, which are slightly tilted from the vertical, so that the lower part is slightly in advance of the upper part.

Q. 59. In the Exhibit Sketch E are the wings or blades C supposed to be at equal angles?

A. Yes.

Q. 60. How much of your time was spent by you in making these experiments and in studying the question as to how peroxide of hydrogen could be made by machinery from the time that you conceived the idea of doing so until the time that you obtained the result shown in your patent?

A. It lasted about seven months before I got the perfect result, and I was thinking about the matter nearly all the time.

Q. 61. What expenses were you put to in attaining the result reached in your patent apart from the time occupied?

A. I spent about $1,500 before I got through.

Adjourned to Thursday, November 13th, 1884, at 10 a. m.

85 NEW YORK, *November 13th*, 1884—10 a. m.

Met pursuant to adjournment.

Counsel present as before.

Q. 62. State how your recent sales compare with your sales when you first began to use your present apparatus.

Objected to as irrelevant and immaterial.

A. The sales increased largely; certainly ten times more now.

Q. 63. You have stated that in June or July, 1880, you reduced the price to six dollars and forty cents per gallon. State what the price is at the present time.

Same objection.

A. At the present time the price is $1.75 per gallon.

Q. 64. State as nearly as you can when you reduced the price from $6.40, and to what price you then reduced it.

A. The last part of 1880 I reduced it to $5. It was sold in five-pint bottles at $36 per dozen.

Q. 65. When was the next reduction made, and to what price?

Same objection.

A. It was in May or June, 1881, I reduced the price to $3.25—$16.25 for 5-gallon demijohns.

Q. 66. To what price was the next reduction made, and when was it made?

Same objection.

A. In October, 1881, I reduced the price to $2.50 per gallon—say $12.50 for 5-gallon demijohn.

Q. 67. When was the next reduction made, and to what price?

Same objection.

86 A. The last part of 1882 I reduced the price of a 5-gal. demijohn to $11. In April, 1883, I reduced it to $9 per 5-gal. demijohn. In July or August, 1883, I reduced it to $8, which is the price now.

Q. 68. When did you first ascertain that the defendant was supplying the market with hydrogen peroxide?

Same objection, and a further objection that it is not rebuttal testimony.

A. In the beginning of January, 1883.

Q. 69. Has the cost to you of producing hydrogen peroxide increased or decreased since you began to make it?

Last previous objection repeated.

A. Yes; it has decreased largely.

Q. 70. What are the causes of the decrease.

A. The causes of the decrease are, first, the cost of binoxide of barium, which is reduced by the fact that I manufacture it myself,

and besides that the method which I employ for the manufacture of peroxide of hydrogen, which gives me the possibility to produce six hundred to eight hundred gallons, fifteen volumes capacity, in one operation. I avoid by this method the chances of loss during the process, according to the regularity of the simultaneous movements in horizontal and vertical ways, these movements producing in the mass constant changing eddies.

Q. 71. How much binoxide of barium do you use per gallon in making hydrogen peroxide of 15 volumes capacity?

A. I use not quite two lbs. per gallon; 9 lbs. for 5 gallons.

Same objections.

Q. 72. How much did the binoxide of barium formerly cost you per pound?

A. Formerly, in 1880, I have paid $1.75 per pound.

87 Q. 73. And how much does it cost you now per pound?

A. Thirty cents per pound.

Q. 74. Could you purchase the same quality of barium that you use in the market at this price?

A. No, sir.

Q. 75. Does the fact that you prepare it in very large quantities influence the cost?

A. Yes; it has decreased the cost much. At first when I started to manufacture binoxide of barium—every day that I manufactured I produced 50 lbs. of binoxide of barium—then it cost me an average of 45 cents per pound. Now I manufacture 500 lbs. and the cost is reduced to about 30 cents.

Q. 76. What is the largest kettle that you use at the present time?

A. Eight hundred gallons capacity.

Q. 77. How long have you used it?

A. Since July, 1884.

Q. 78. Have you used this kettle and successfully?

A. Yes, sir; very.

Q. 79. How many gallons of hydrogen peroxide have you made in it at one operation?

A. Seven hundred and twenty gallons.

Q. 80. Could a mass of the mixture sufficient to fill that kettle or a mass anywhere approaching the same size be stirred by hand?

A. No, sir; it is a practical impossibility.

Q. 81. Suppose the binoxide of barium and the acid solution be stirred by hand, what proportion of the material would be wasted by an ordinary workman?

A. It would certainly be at least 10 per cent. with the most careful laborers you could employ, and generally it would be 25 or 30, according to the carelessness of the laborer, and particularly in the case of using a big kettle of 800 gallons capacity the laborer could not stir it at all.

Q. 82. Suppose you undertook to make at one time as large

88 an amount by hand in a sufficient number of smaller kettles or tubs where the mass could be manipulated by hand stir-

ring, would it be possible for you to personally supervise each laborer employed in the stirring?

A. It would be very difficult and nearly impossible to supervise all the laborers, because the work of each one must be perfectly regular, and you cannot expect that every one will stir the mixture with the same care according to the weight of the binoxide of barium and the insoluble salts of barita which are in the mixture and have to be kept in constant motion in order to prevent the solid substances from settling at the bottom.

Q. 83. Is the binoxide of barium that can be obtained for use in making peroxide of hydrogen chemically pure?

A. No, sir.

Q. 83½. With what is it mixed?

A. The binoxide of barium found in the trade contains, with many impurities, oxide of iron, oxide of manganese, alumina, silica, caustic barita, carbonate of barita, more or less, and a few others which have no importance.

Q. 84. In making hydrogen peroxide by your patented method do you have any difficulties arising from the presence of oxide of iron or oxide of manganese?

A. No.

Q. 85. When you made it by hand were such difficulties encountered?

A. Yes.

Q. 86. What loss, if any, arose from the presence of oxide of iron and oxide of manganese in the mixture?

A. It decomposes very rapidly the peroxide of hydrogen solution.

Q. 87. Why was this?

A. Because the mixture of the fluid part with the solid particles of binoxide of barium was so incomplete that a large amount of the binoxide of barium which settles at the bottom was not brought
89 in contact with new particles of acid in sufficient quantities to transform the oxide of iron and oxide of manganese in the corresponding salts. The salts of iron and manganese decompose peroxide of hydrogen very slowly, but the oxides of iron and manganese decompose it very rapidly, and beside that the binoxide of barium when it is not in motion at the bottom of the kettle accelerates also the decomposition of peroxide of hydrogen.

Q. 88. Well, in this decomposition what is lost?

A. Oxygen gas is escaping and is lost.

Q. 89. Is chemically pure binoxide of barium purchasable in the market for industrial uses?

A. No, sir; it is a product of curiosity. It is not manufactured except on order.

Q. 90. How much would it cost per pound?

A. At least $2.50—and maybe $3.00 per pound in France. It costs twenty-five francs per kilo at the present time. One kilo is about two pounds and three ounces.

Q. 91. Will you please produce two pounds of anhydrous binox-

ide of barium, such as you ordinarily use in making peroxide of hydrogen in a half-pint bottle?

A. Yes; I will do so.

Q. 92. How much does a pint of water weigh?

A. One pound.

Q. 93. And what is the specific gravity of the binoxide of barium such as you ordinarily use?

A. About three times more than water.

Q. 94. When you formerly did the stirring by hand how much binoxide of barium was ordinarily used in making of hydrogen peroxide?

A. Formerly I was making the peroxide at ten or twelve volumes, and I was using, per gallon, about two pounds of binoxide for the twelve volumes and one pound and two-thirds to make the ten volumes.

Q. 95. When you speak of hydrogen peroxide of ten,
90 twelve, or fifteen volumes you mean this, do you not: That the hydrogen peroxide referred to is not chemically pure hydrogen peroxide, but it is dissolved in water, and that if you were to decompose a given quantity of the solution it would produce oxygen gas to an amount, in bulk, ten, twelve, or fifteen times the bulk of the solution thus dissolved?

A. Yes; it is right, with this explanation: If I decompose one pint of the peroxide of hydrogen solution of ten volumes capacity it will give forth ten pints of oxygen gas, at the ordinary atmospheric pressure, and a pint of water will remain. There is, of course, a trifling loss, which is hardly perceptible, in weight.

Q. 96. When you stirred peroxide of hydrogen by hand did you ever make it of fifteen volumes capacity?

A. No, sir. I could not reach such a concentration by hand; I mean industrially. I could make a pint easily.

Q. 97. Why could you not do it?

A. Because the risk of losses by making by hand becomes so great that the oxygen escapes very easily when I try to go over the concentration of ten volumes capacity, and the best I could do was twelve volumes capacity.

Q. 98. Is its efficiency as a bleaching agent increased as the concentration is increased?

A. Yes, sir.

Q. 99. Is the quantity of binoxide of barium that you use in making a given quantity of the solution increased as you increase the concentration of the solution?

A. Yes, sir.

Q. 100. Have you endeavored to find the circular referred to in questions 9 to 14, inclusive; and, if so, with what result?

A. I have looked for but could not find it. I have moved three times since, and the firm name was changed and many of the old papers thrown away.

91 Cross-examination:

Q. 101. You have stated that when people called upon you after

you sent out your circular that you explained to them your process of manufacture.

A. No; I did not say manufacture. I said my process of bleaching.

Q. 102. What was there in the process of bleaching to explain?

A. I explained the way to apply the peroxide of hydrogen to the bleaching of raw ostrich feathers. I told them to wash the feathers at first, to soak them in a bath composed of one gallon ammonia solution, twenty degrees, to five or seven gallons of plain water during about four to eight hours; then take them out of the bath, squeeze out the liquid, put them in a wooden or porcelain tub, and prepare in another tub the bath of peroxide of hydrogen by adding to it one pint aqua ammonia at twenty degrees; as soon as the peroxide of hydrogen bath is so prepared pour it on the feathers which are in the tub; put that tub which contains the feathers and the peroxide in a very hot room, about ninety to one hundred and ten degrees; let it stay in that room until the peroxide of hydrogen is exhausted. Then you take out the feathers, which have to be rinsed, and if they are not white enough they will have to be put in a second bath of peroxide prepared as the first one.

Q. 103. Has not the market price of binoxide of barium decreased very largely in the last five years?

A. Yes; it has decreased very largely since the last part of 1881; in 1882 the market price was $1; I sold some at $1 per pound; in the last part of 1882 it fell to 75 cents per pound, and in 1883 it fell to 45 cents per pound for the best quality, and now for the best quality the market price is 38 to 40 cents per pound.

92 Q. 104. Is it an article of merchandise to a very great extent for other purposes than the manufacture of hydrogen peroxide?

A. Yes; it is.

Q. 105. Would not the extent to which the binoxide of barium settles to the bottom of the receptacle, as illustrated in Complainant's Exhibit Sketch C, depend very largely upon the manner in which it is added or introduced to the acid solution during the process of stirring?

A. I don't know what you mean exactly.

Q. 106. If the binoxide of barium were added to the acid solution in small quantities at a time would it settle to the bottom as much as if it were added in large quantities?

A. Of course not.

Q. 107. Then if it were added in small quantities and at proper intervals would there be much loss from its settling to the bottom?

A. Yes; because the smallest quantity of binoxide which remains idle at the bottom provokes very rapidly decomposition of the hydrogen peroxide solution which has been produced.

Q. 108. If added in small quantities and at frequent intervals would any considerable quantity settle to the bottom at all?

A. Yes; as I explained before, the great weight of the binoxide of barium makes it fall to the bottom very rapidly if the mixture don't receive a proper vertical and horizontal movement.

Q. 109. Then what do you mean by your previous answer to cross-question 106, that the extent to which the binoxide will settle to the bottom depends upon the manner in which it is added?

Counsel for complainant suggests that the scope of the answer is misapprehended.

A. I mean that in case, for example, I should put at a
93 time in the acid solution, say, 5 lbs. of binoxide of barium properly prepared, the half of this quantity, and probably more, will settle at the bottom at once; and in case the quantity be very small, it being practically possible, say, to put in, for example, one or two ounces, it will be perfectly impossible with such apparatus to prevent the falling down of the binoxide of barium in about the same proportion as before.

Q. 110. Then you say that the proportion of binoxide of barium which will settle to the bottom is about the same, whether it is added in large or small quantities and at frequent or infrequent intervals?

A. Yes. You will have all the time at the bottom of the kettle a relatively large proportion of binoxide of barium which will be idle and which will be largely sufficient to provoke the decomposition.

Adjourned to Saturday, November 15th, 1884, at 10 a. m.

NEW YORK, *November* 15, 1884.

Met pursuant to adjournment.

Counsel present as before.

Question 110 repeated to give witness an opportunity to correct his answer or give further answer.

A. Instead of saying yes, you will have all the time at the bottom of the kettle a relatively large proportion of the binoxide of barium which will be idle and which will be largely sufficient to provoke decomposition, I now say that the proportion of binoxide of barium which will settle down when added in large quantities will be greater
94 than when the binoxide of barium will be added in small quantities to the acid solution, it being understood that the volume of the liquid which received the rotary movement is the same in both cases and the degree of acidity being the same.

Q. 111. Now, will the proportion of the binoxide of barium which settles to the bottom also be affected by the degree to which it is hydrated when added to the acid solution?

A. Yes.

Q. 112. Then if the binoxide of barium be hydrated so as to be quite thin and is then added to the acid solution in small quantities at a time would not the amount which would settle to the bottom be quite small as compared with the amount which would settle if it were added in large quantities and so hydrated that it would be quite thick?

A. When binoxide of barium is hydrated chemically it always contains the same proportion of water, which is combined with anhydrous binoxide of barium.

Q. 113. Then what do you mean by your answer to question 111?

A. I mean that if the binoxide of barium is not entirely hydrated the binoxide will fall down more rapidly and consequently in a larger proportion, because the portion of binoxide which is not thoroughly hydrated is not attacked so easily by the acid solution.

Q. 114. Is not the only object to be accomplished by stirring the mixture to bring the particles of barium in contact with fresh particles of the acid solution?

A. Yes; it is. The object of stirring is precisely to prevent the settling at the bottom of the binoxide.

Q. 115. Would it make any difference whether the barium settled or not if its particles came in contact with fresh particles of the acid solution equally fast when settled as when in motion in the mixture?

95 A. Of course not; but such a thing is impossible.

Q. 116. You stated on direct examination that it was known that several articles could be bleached by hydrogen peroxide before you began its manufacture. Is there any substantial difference in the method or process by which different articles are bleached by hydrogen peroxide?

A. Yes; there are some substances for which the process is quite the same; for instance, hair, ostrich feathers, silk, ivory, and bones, all are very much the same; there are some others not generally known to the trade which are different.

Q. 117. Then the articles which it was known hydrogen peroxide would bleach before you began the manufacture of it were bleached by substantially the same process by which feathers and other articles, which you have spoken of as having become much more extensively bleached by hydrogen peroxide, are bleached?

A. Yes; it was nearly the same process.

Q. 118. You stated, in answer to question forty-five, that the particles of fluid shown at or near the surface "C" in sketch C tend to fall to a lower level because of the centrifugal force; can you explain more definitely and fully what you mean by this?

A. I mean by this that if I make a cross vertical section I have the liquid raising on the edge; consequently it is falling slightly at the centre, as it is represented on the sketch, and the curve of the surface remains the same when the condition of the rotation remains the same also.

Q. 119. I now understand you to mean that the centrifugal force tends to make the liquid higher at the outside than at the centre, and that the only influence which tends to make the liquid at C in sketch C fall to a lower level is the natural tendency of liquid to run down-hill?

A. No; it is not that. The centrifugal force produces the
96 rising up of the liquid at the edge of the kettle, and, the volume of the liquid remaining the same, a depression at the centre is the consequence of the rising up at the outer edge. Just as soon as the centrifugal force stops, then the liquid, according to the natural law, will fall and take its horizontal level.

Redirect examination:

Defendant's counsel concedes that sufficient foundation for the introduction of secondary evidence as to the contents of circulars has been laid.

Q. 120. Look upon the two bottles that I now show you and state their capacity and what they contain at the present time.

A. These are two one-pint bottles; one of them contains one pound of plain water; the other one contains two pounds of anhydrous powdered binoxide of barium; the first is almost full, and the other is a little over two-thirds full.

Complainant's counsel offers in evidence the two bottles referred to and their contents, and the same are respectively marked Complainant's Exhibit Plain Water, Nov. 15th, 1884, J. A. S., examiner, and Compl't's Exh. Anhydrous Binoxide, Nov. 15, 1884.

Q. 121. When you use the binoxide of barium in making hydrogen peroxide it is hydrated, is it not?

A. Yes.

Q. 122. If you produced a quanity of hydrated binoxide of barium ready for use about how long would it be before it began to decompose, supposing it to be in a bottle similar to those just produced?

97 A. As soon as it begins to be hydrated it takes six to ten hours; then it begins also to be carbonated.

Q. 123. Suppose you produced a couple of pounds of hydrated binoxide of barium ready for use in a bottle, would it continue to be in the same condition a month hence as it is now?

A. No, because the binoxide of barium when hydrated absorbs very rapidly the carbonic acid of the atmosphere, and is transformed gradually into carbonate of baryta; and, besides that, it would become agglomerated and would not be in the state in which it is when I am using it, which is a thick milky form.

Q. 124. You have stated that you have been accustomed to make your hydrogen peroxide at fifteen volumes capacity, stirring it by machinery. Have you ever made it in quantities by your patented process of a higher degree of concentration?

A. Yes. I have made it at twenty-five volumes twice. It was for P. T. Barnum & Co. I made thirty gallons at a time, according to the order. I have made it at twenty volumes capacity in larger quantities. In the same kettle I have made sixty or seventy gallons of this capacity. This was done on special orders and for special purposes.

Q. 125. Have you been informed for what purpose the hydrogen peroxide was used which you have just said you made for P. T. Barnum & Co.?

A. I was informed that it was used for the purpose of bleaching the skin of one of their elephants.

C. MARCHAND.

Sworn to before me—

JOHN A. SHIELDS, *Examiner.*

98 Counsel for complainant gives notice that at the hearing of this cause he shall apply to the court for permission to produce before the court a small quantity of hydrated binoxide of barium prepared as it ordinarily is for use in making peroxide of hydrogen, the condition and identity of the same to be proved in such manner as the court may direct. The reason it is not produced at the present time is because from its nature its condition would be so changed at the time of the hearing of this cause that it would rather mislead than assist the court if it were offered now.

Adjourned to new notice.

99 Circuit Court of the United States for the Southern District of New York. In Equity.

CHARLES MARCHAND, Complainant,

vs.

FREDERICK EMKEN, Defendant.

Notice is hereby given that we shall proceed to take proofs for final hearing on the part of the complainant, under the 67th rule of the Supreme Court for courts in equity, as amended, or in accordance with the statutes in such case made and provided, and in pursuance of the rules and practice of this court, before an examiner of this court or other proper officer under said statutes and rules, at the office of A. Pollok, 635 F street, Washington, D. C., on the 1st day of December, 1884, at 11 o'clock in the forenoon.

The names and residences of the witnesses whom it is intended to examine and to whom the provisions of § 863 of the Revised Statutes of the United States are applicable are stated below.

100 You are invited to attend and cross-examine any witnesses produced. The examination will be adjourned from day to day and to such time and place as may be required without further notice.

Dated New York city, Nov. 24th, 1884.

TURNER, LEE & McCLURE,
Solicitors for Complainant, 20 Nassau Street, New York.

To M. P. Stafford, Esq., defendant's solicitor.

Name of witness, Charles J. Hedrick; residence, Washington, D. C.

The examination under the foregoing notice is hereby adjourned to Monday, Dec. 8, 1884, at same hour and place.

MARSHALL P. STAFFORD,
Defendant's Solicitor.

United States Circuit Court, Southern District of New York. In Equity.

CHARLES MARCHAND *vs.* FREDERICK EMKEN.

Testimony taken *de bene esse* under and pursuant to the 67th rule of the Supreme Court, as amended, and the provisions of the Revised Statutes of the United States, before Philip Mauro, a
101 notary public in and for the District of Columbia.

Met, pursuant to notice annexed, at No. 635 F street, Washington, on December 8, 1884.

Present: W. H. L. Lee, of counsel for complainant.

CHARLES J. HEDRICK, a witness produced on behalf of said complainant, being duly sworn, in answer to interrogatories propounded by Mr. LEE testified as follows:

Q. 1. What is your name, age, residence, and occupation?

A. Charles J. Hedrick; age, 29 years; residence, Washington, D. C.; occupation, attorney in patent cases; am member of the bar of the supreme court, D. C.

Q. 2. State to what extent you have been engaged in the study of chemistry and what experience, if any, you have had in the examination of letters patent for inventions and in connection with applications for the same before the U. S. Patent Office.

A. In 1874 I was graduated by the University of New York as bachelor of arts, the course for which degree included lectures in physics and chemistry and also experimental work in the chemical laboratory. From the fall of 1874 to the spring of 1878 I was employed in the U. S. Patent Office, principally as assistant examiner in chemical divisions, my duties being mainly examination of applications for patents as to novelty and patentability of the inventions therein described and the preparation of digests of the patents previously granted on given subjects. Since the spring of 1878 I have been engaged in preparing specifications of new inventions for
102 letters patent, in making examinations among the United States and foreign patents, and also among printed publications to ascertain the novelty of inventions, patented and unpatented; in giving opinions as to the validity, scope, construction, and infringement of patents; in conducting applications before the Patent Office, and in other like employments.

Q. 3. Are you acquainted with the French and German languages?

A. I can read the French used in scientific and industrial works with facility, and have a sufficient acquaintance with German to understand and translate the same with the assistance of a dictionary.

Q. 4. State whether or not you have made a special study of peroxide of hydrogen, particularly as regards its discovery, the different methods of making the same, and the obstacles which have been encountered in making it, as well as its qualities and its usefulness.

A. I have made careful study of scientific publications in French

and English which treated of the subject, and to a certain extent in German. I made somewhat of an examination of the subject about two years ago, and recently I have made a very careful one. I have read the present standard and the old text books, so far as accessible, and have further examined the scientific journals which it appeared likely would treat of peroxide of hydrogen.

Q. 5. State some of the works you have consulted.

A. Thenard's Chimie, Berzelius' Traité de Chimie, Gmelin's Hand-Book of Chemistry, Roscoe's Lessons in Elementary Chemistry, Miller's Elements of Chemistry, Fowne's Elementary Chemistry, Draper's (Henry) Chemistry, Barker's College Chemistry, J. P. Cooke's Chemical Philosophy, Roscoe & Schorlemmer's
103 Treatise on Chemistry, Payen's Industrial Chemistry (Paul), Watt's Chemical Dictionary, with supplements; Wurtz's Dictionaire de Chimie, Journal of the London Chemical Society, American Journal of Chemistry, Le Technologiste, and others.

Q. 6. Will you please state, as the result of your researches, by whom peroxide of hydrogen was first made, the various methods of making the same which have been used and approved by chemists, the uses in the arts and otherwise of which peroxide of hydrogen was found to be capable, the difficulties, if any, which were found in making it, and the obstacles, if any, which prevented it for a greater or less time from being used industrially for the purposes to which scientific men found it adapted; and in giving your answer please make reference to the various books and printed publications from which you derive your information, and in such cases as you deem proper produce extracts from the same.

(Objected to as irrelevant, immaterial, and not rebuttal evidence.)

A. Hydrogen peroxide or peroxide of hydrogen, otherwise called oxygenated water, also hydrogen dioxide, was discovered by Thenard in 1818. For this purpose he decomposed binoxide of barium or other suitable base with a dilute acid, producing a salt of the base and hydrogen peroxide—for example, $Ba O_2 + 2 H Cl + aq = Ba Cl_2 + H_2 O_2 + aq$.

This reaction is at the foundation of all the useful methods of making the substance. The peroxide of hydrogen can, however, be produced otherwise, as by electric action, or by the slow oxidation of phosphorus, and is in fact produced in minute quantities in nature. These last-named methods have only a theoretic value.

Thenard's original process has been considerably improved or modified by himself and others. According to his latest
104 mode, binoxide of barium is decomposed with hydrochloric acid ($Ba O_2 + 2 H Cl + aq = Ba Cl_2 + H_2 O_2 + aq$); the chloride of barium formed is decomposed with sulphuric acid ($Ba Cl_2 + H_2 SO_4 = Ba SO_4 + 2 H Cl$); the insoluble sulphate of barium is separated by filtration, and phosphoric acid and baryta water and sulphate of silver are used to get rid of the impurities. Several of these operations are repeated. An extract from Watt's Dictionary, published in 1875, will be given, showing the process in all its details.

The operation can be shortened by cooling the vessel with a mix-

ture of ice and salt, which causes the chloride of barium to precipitate out.

Pelouze substituted hydrofluoric acid (HF.) or hydrofluosilicic (H_2 Si F_6) for hydrochloric acid used by Thenard. The reaction, using hydrofluosilicic acid, is Ba O_2 + H_2 Si F_6 + aq = Ba Si F_6 + H_2 O_2 + aq.

The fluosilicate of barium, being insoluble, separates at once from the liquid, so that it was not necessary to use sulphuric acid as in Thenard's process.

Duprez and others (1862) used currents of carbonic acid gas (carbon dioxide C O_2) to decompose the binoxide of barium, the equation being Ba O_2 + H_2 C O_3 + aq. = Ba C O_3 + H_2 O_2 + aq.

Thomsen (1874) prepared a purified binoxide of barium, and decomposed this with dilute sulphuric acid. He dissolved the commercial binoxide of barium in hydrochloric acid; then added baryta water enough to precipitate impurties; then decanted the liquid and added baryta water to precipitate barium binoxide. The precipitate was carefully preserved and used as occasion required, being added to dilute sulphuric acid.

Ba O_2 + H_2 S O_4 + aq. = Ba S O_4 + H_2 O_2 + aq.

In decomposing the binoxide of barium it was customary to stir the acid. The stirring was done by hand, by means of a glass rod.

The above processes make the state of the art prior to complainant's patent.

105 The uses of the peroxide of hydrogen are various.

Thenard applied it to removing the stains from old paintings. He found it was a powerful oxidizing agent, and would bleach vegetable colors, such as litmus.

Berzelius in his chemistry, speaking of hydrogen, says: "Cette liqueur blanchit et detruit toutes les couleurs végétales." (This liquid bleaches and destroys all vegetable colors.) Traité de Chimie, Paris, 1845, Tom. I, p. 428.

In 1862 Chevreul bleached various solutions of vegetable colors. The conclusion he drew from his experiments was that "L'eau oxygenée décolore les principes colorants d'origine organique a la manière de l'eau de chlore mais plus lentement." (Peroxide of hydrogen decolorizes coloring matters of organic origin like chlorine water, but more slowly.) Comptes Rendus, Paris, 1862, vol. 55, p. 737; also published in Le Technologiste, Paris, 1863, vol. 24, pp. 238 and 239.

Previous to 1878 peroxide of hydrogen had been used in medicine; also as an auricome to bleach colored hair. An auricome is a means of making the hair golden or yellow. It is derived from *aurum*, gold, and *comæ*, hair of the head. In or before 1881 it was used to bleach ornamental feathers and silk; also as a disinfectant.

Its use as a reagent in quantitative analysis has also been proposed recently, and as early as 1878 it was proposed to use it for bleaching cloth and for other purposes.

Hydrogen peroxide consists of the same elements as water, but with a double quantity of oxygen, whence the name oxygenated water. This additional oxygen is very loosely bound to the other

elements, and is separated very readily. From this cause principally it is difficult of manufacture. The preparation of binoxide of barium, used to produce hydrogen peroxide, is liable to de-
106 compose the hydrogen peroxide formed. Should this latter be decomposed the liberated oxygen escapes and is lost.

Great care is therefore necessary in order to avoid loss.

The product called hydrogen peroxide is in fact a solution, more or less concentrated, of that substance in water. In a very dilute solution it is less unstable than in a more concentrated one. As, therefore, the proportion of hydrogen peroxide in the solution rises, greater care has to be exercised.

Thenard overcame the difficulties by treating a very small quantity of liquid (less than a half pint) and adding the binoxide of barium in very minute quantities (less than half an ounce of barium binoxide is to be added in several portions) and removing the precipitate soon after it forms. This, of course, required a long time to make a small quantity of the hydrogen peroxide.

The methods of Pelouze and Duprez are recommended only when dilute solutions are to be made. Thus Wurtz, "Dictionaire de Chimie," Paris, 1876, Tome 1, p. 1197, speaking of these processes, says: "Mais quand on veut avoir de l'eau oxygenée concentrée et pure, on est toujours obligé d'en revenir au procédé de Thenard." (But when it is desired to produce peroxide of hydrogen concentrated and pure it is necessary always to return to the process of Thenard.

Berzelius says, p. 430 of the work before referred to, that Thenard, while he recognized that the operation would be much shortened if the barium binoxide were treated with sulphuric acid, was obliged to resort to his indirect mode because the larger part of the gas escaped as gas.

Thomsen, indeed, uses sulphuric acid, but he first decomposes the ordinary preparations of binoxide of barium with hydrochloric acid, separates part of the impurities by precipitation and decan-
107 tation, reconstitutes the binoxide of barium, and then decomposes this reconstituted and purified binoxide of barium with the sulphuric acid. Evidently, as in other processes, it requires care to avoid loss by decomposition of the peroxide after it is formed.

This process seems to be regarded as better for many purposes than those previously known, but it did not render the production of peroxide of hydrogen cheap enough to allow it to be used in many industries to which it is known to be suited.

Thus, in Paul's edition of Payen's Industrial Chemistry, published in London, 1878, page 39, it is said:

"If hydrogen peroxide were cheaper it might be used with advantage for cloth bleaching."

In Wagner & Gautier's Nouveau Traité de Chimie Industrielle, published at Paris in 1879, vol. 2, page 619, after referring to the utility of hydrogen peroxide as a bleaching agent, it is said that the application to bleaching "est encore dans l'avenir" (is still in the future—*i. e.*, is an application to be made by means yet to be invented).

In an article in the "Chemical Society Journal" (London), published in London, 1881, new series, vol. 40, 1881, Abstracts, page 474, it is said: "The use of the peroxide (of hydrogen) for the above purposes (principally disinfecting and bleaching) on a large scale is very much limited by its costly nature, and any cheap method of preparation would largely extend its sale."

The valuable properties of hydrogen peroxide for many useful purposes were therefore long known, but its use was limited by its costly nature, due to the difficulties in its manufacture.

I produce a number of extracts as part of my answer to this question. At the head of each extract the title of the publication from which it is taken is stated, with the page at which the extract can be found; also the date of each publication as it purports in
108 each case to have been published. Those extracts which are in French and German I have translated.. The translations which I also produce are correct, as are the translations of the extracts which I have embodied in my answers thus far—the translation immediately following the original.

Counsel for complainant offers in evidence the extracts and translations produced by the witness, and the same are marked "Complainant's Exhibit Extracts from Scientific Works, Dec. 8, 1884, P. M., notary public."

(The defendant moves to strike out of the answer to question 6 the paraphrase of the translation of the words "est encore dans l'avenir," as follows: "*i. e.*, is an application to be made by means yet to be invented," on the ground that the words and their literal translation must speak for themselves and the witness has no right to put upon them any other construction. The defendant objects to the exhibits offered at the close of answer to question 6 on the same grounds upon which the question itself is objected to.)

Q. 7. Have you read and do you understand the testimony of Theodore F. Kionka, given in this suit, and have you examined the sketch referred to in his evidence, and do you understand the structure stated by him to be used by the defendant and the mode of operation of the same, and have you read and do you understand the evidence of Charles Marchand and Frederick Emken in reference to the same?

A. I have and do.

Q. 8. Have you examined the specifications and drawings of letters patent numbered, respectively, 33154, 88016, 131,283, 152,895, 216,053, 222,547, and 249,256, and also the complainant's patent, No. 273,469, and do you understand the same?

109 A. I have and do.

Q. 9. In connection with the state of the art of making peroxide of hydrogen as it existed at the date of complainant's application for his letters patent, as already testified to by you, please state whether or not, in your opinion, the letters patent mentioned in question 8 (apart from complainant's patent) or any of them show the invention described in complainant's patent and claimed

in the first claim thereof, and give reasons for your views, with any illustrations that occur to you.

(The defendant objects to question 9 on the same grounds upon which question 6 was objected to, and on the further ground that it calls for a legal conclusion, which it is the province of the court and not that of the witness to draw.)

A. I have read and examined all of them and understand the same. Some of them show a stirrer in many respects like that shown in complainant's patent, and which might perhaps be used, in making peroxide of hydrogen, to produce the rotary movements of complainant's patent. None of these relate to the manufacture of hydrogen peroxide, nor to any analogous art, nor to the making of any analogous substance. In none of them is it sought to produce an unstable compound like hydrogen peroxide, decomposable with great readiness, and often under the most enigmatical circumstances; nor in any of them is a small quantity of a heavy solid in a fine state of division sought to be evenly diffused in a liquid of, say, one-third the specific gravity of the solid.

The complainant's patent shows new means for the manufacture of peroxide of hydrogen. Stirrers of various kinds have been used to impart motion to liquids, and screws may have been used for the same purpose—in churning milk, for example; but the screw, or its equivalent, is not itself the means specified in the patent.

110 These means are the giving to the acid, by means of a screw, or its equivalent, the combined movements of rotation in connection with the addition of the binoxide of barium in small quantities and the cooling of the liquid. The screw is simply an instrumentality for giving the desired rotation. It, or its equivalent, is a part only of the means. The novelty of the means is not dependent upon the novelty of the screw.

I may make my meaning more clear by illustration. In engraving by means of the sand blast the device for shooting a stream of sand against a plate in order to engrave the same is only a part of the means for engraving the plate. The proper application of the stream to the plate is just as essential. If the same device for squirting sand were old for driving cows from a railroad track the means for engraving by sand blast would still be new. In the propulsion of vessels by a screw the existence of the ordinary windmill, which operates on the principle of the screw propeller, would not make the means of propulsion to be old. The means for carbureting air by using a gas metre of the wet metre kind as a pump to force the air through the hydrocarbon liquid would be new, notwithstanding the prior existence of the meter as a gas measurer.

The means for freeing a casting of air bubbles or impurities by revolving it in a mold would be new, notwithstanding the prior existence of a centrifugal apparatus for freeing sugar of molasses or for skimming milk, although they all depended for their operation upon the well-known principles of centrifugal force.

The means in these cases are new, just as in the patent, in respect

to the connection in which certain known instrumentalities were employed.

In seeking to improve the manufacture of hydrogen peroxide the inventor of the patented process had to consider in what way
111 to avoid loss of gas, through the decomposition of the hydrogen peroxide after it had been formed, and at the same time to make large quantities of the material in one batch with rapidity, certainty, and uniformity in the product. There was nothing to show at that time that the use of the compound rotation would overcome the difficulties in the way of the practical manufacture of hydrogen peroxide for use in industries to which it was known to be suited.

The extracts I have above referred to show that its bleaching properties were well known, and that for years a large demand for it existed, which could not be supplied by reason of its high price, caused by the difficulty of its manufacture.

(The defendant moves to strike out from the answer the following words: "The complainant's patent shows new means for the manufacture of peroxide of hydrogen," on the ground that it is a conclusion of law, which it is the province of the court and not of this witness to draw, and on the same ground moves to strike out the whole of the paragraph beginning, "In seeking to improve the manufacture of hydrogen peroxide" and closing with the words "for use in industries to which it was known to be suited.")

Q. 10. Suppose some one skilled in the art of making peroxide of hydrogen, and having knowledge of everything that was known in the art of making peroxide of hydrogen at the date of the complainant's application, excepting, of course, what the plaintiff afterwards disclosed in his patent, had read and examined carefully the patents referred to in Q. 8 (except complainant's patent), in your opinion would they have disclosed to him the invention described in complainant's patent and claimed in the first claim thereof, or
112 would they have enabled him to do what the complainant does in following out his patented process?

(Defendant objects to question 10 as irrelevant, immaterial, not proper in rebuttal, incompetent, and on the ground that this witness can only speak for himself and what he could understand and do, and not what some one else might be able to understand and do.)

A. They would not have disclosed nor suggested the new process therein claimed for the reasons I have already stated.

Another reason is the fact that while every chemist knew as well without reference to those patents as he would after reading them that a screw could be used for mixing, no chemist suggested the application of the same to the manufacture of hydrogen peroxide as pointed out in complainant's patent.

Adjourned to Tuesday, December 9, at 11 o'clock.

TUESDAY, *Dec. 9th*—11 a. m.

Met pursuant to adjournment.
Present: As before.

Q. 11. In connection with the state of the art of making peroxide of hydrogen as it existed at the date of the complainant's application for letters patent, in regard to which you have already testified, please compare the method of making peroxide of hydrogen as described in the complainant's patent and claimed in the first claim of the same with the method used by defendant, as appears
113 by the testimony of the witnesses, Kionka, Marchand, and Emken.

(Defendant objects to Q. 11 on the ground that it is not proper as rebuttal evidence.)

A. The method used by Emken, and also that set out in complainant's patent and claimed in the first claim thereof, is based upon reactions well known in the art and discovered by Thenard; but in both the dilute acid is given a movement which had never before been imparted to it in the manufacture of hydrogen peroxide, and which the patentee claims as new in that art. Instead of giving simply the movement round and round in horizontal planes, which is given in hand stirring, the liquid is given also a rotation in vertical planes—that is to say, the liquid is thrown out towards the circumference of the vessel at the bottom, rises at the sides, returns to the centre, and then descends, to be again thrown out at the bottom, while at the same time it is carried round and round.

The effect of this movement is to carry along the binoxide of barium so that its particles, notwithstanding their weight, are constantly brought up to the top of the liquid as well as carried round and round the axis of the vessel. In both the process used by Emken and that of the patent the revolving blades would carry around the liquid in the receptacle and thus give it a rotation in horizontal planes. The centrifugal force generated by the rotary motion would cause the liquid to rise along the inside wall of the vessel and descend in the center, thus giving a rotation in vertical planes. This vertical rotation would be assisted, in the case of the patented apparatus, by the inclination of the blades, in the Kionka or Emken apparatus by the stationary blades E.

114 The effect of the inclination of the blades, as shown in the patent, is to make the centrifugal action greater in the lower part of the receptacle or zone in which the blades move. The stationary blades also make the centrifugal action greater in the zones in which the rotary blades move. There is a slight difference in the mode of doing this. The inclined blades exert a pressure upon the liquid downward, and not being able to advance in that direction it goes outward and upward. The stationary blades, by holding back the liquid, diminish the centrifugal force of the particles in those zones—that is, the zones between the rotary blades and above the upper one. The particles in those zones are there-

fore carried towards the center, and are there drawn in by the rotary blades, and again thrown to the circumference. If all the liquid from top to bottom of the receptacle had the same rotation about the central vertical line the centrifugal force in one zone would balance that in another, and while the liquid would rise higher at the circumference than in the center there would be little rotation of the liquid in vertical planes.

Moreover, the rotary blades in both forms of apparatus in moving through the liquid produce eddies similar to those made by the blade of an oar in rowing a boat.

Emken also cools the liquid in the vessel and adds binoxide of barium thereto from time to time in small quantities.

In my opinion, therefore, the process set forth in the depositions of Kionka and Emken is precisely the process specified in the first claim of complainant's patent. There is no substantial difference.

Adjourned to Saturday, December 13, 1884, at the same hour and place.

PHILIP MAURO, *Notary.*

115 Q. 12. State whether or not you have ever witnessed the operation of making peroxide of hydrogen as described in the complainant's patent or any portion of said operation; and, if so, state what you observed in regard to the motion of the materials in the vessel while the screw was revolving.

A. I witnessed a portion of the operation of making peroxide of hydrogen at Mr. Marchand's about four weeks ago. I did not observe the process from beginning to end, as I was informed that it was a continuation of the same thing, so far as any portion covered by the patent is concerned. The vessel used was a very large one, containing several hundred gallons, and was the largest I saw in Mr. Marchand's establishment. When the screw revolved the liquid was naturally forced to a higher level at the circumference than at the centre. This, of course, was necessarily the result of the rotation of the liquid in horizontal planes, no matter what the shape of the vessel or the character of the motion; but I noticed, besides, a constant rushing of the liquid from all portions of the circumference to the centre, and I am certain that there was no portion of the liquid which was not subjected to the double rotation—that is to say, the round-and-round movement horizontally and the movement from the wings of the screw and near the bottom of the vessel, thence up the sides to the outer circumference and the top, and thence flowing over the underlying liquid into the centre again. I saw quantities of binoxide of barium poured in, and from the nature of the motion of the liquid it was impossible that any of the binoxide of barium could accumulate in any place for any considerable length of time. Testing with a stick, so far as could be done without interference from the screw, demonstrated that no deposit existed at the bottom of the vessel.

116 Q. 13. You have spoken in a previous part of your examination of the inclination of the blades of the screw tending to

throw the water up in the complainant's apparatus. State whether or not there is anything else in the apparatus as shown in his patent or as used by him which also has a like effect.

A. In the apparatus described in the complainant's patent and that which I saw at Mr. Marchand's factory the bottom of the vessel is concave, as shown in the drawing of the patent, and this assists in throwing the water upward. Owing to the gradual slope upwards of the vessel's walls the liquid, in moving outward over the slope or inclined plane, is necessarily given an upward movement also.

DECEMBER 13TH, 1884.

Met, pursuant to adjournment, at 10 o'clock a. m.

Present: Marshall P. Stafford, Esq., of counsel for defendant.

Counsel for defendant notes his objections to the examination-in-chief as far as proceeded with, and said objections are inserted by the notary after the questions and answers to which they respectively relate.

In answer to questions propounded by Mr. STAFFORD the witness says:

X Q. 14. Did you take a special course in chemistry in the University of the City of New York, or did you only take such instruction in chemistry as the entire class was required to take?

A. The work in the chemical laboratory was additional to the lectures required for the degree and was optional.

X Q. 15. Did you devote yourself specially to work in the chemical laboratory?

117 A. I guess I had better say yes to that.

X Q. 16. How long were you in the New York University?

A. Three years.

X Q. 17. During how many of those years did you study chemistry?

A. One.

X Q. 18. Which of the three years was that?

A. I don't recollect.

X Q. 19. How much time during that year did you devote to practical work in the chemical laboratory?

A. An hour a day for probably three months.

X Q. 20. Who was your instructor in that work?

A. Henry Draper.

X Q. 21. In the course of that work did you do anything in connection with hydrogen peroxide?

A. No.

X Q. 22. Name any students that worked with you in the chemical laboratory there.

A. A. S. D. Thomson, and, I think, also James H. Balston, A. R. Thompson; in fact, a majority of the class of 1874, as may be seen by reference to the university catalogue.

X Q. 23. Do you know where the three gentlemen whose names you have mentioned, or either of them, now are?

A. A. S. D. Thomson, according to my latest information, is in Edinburgh, Scotland; James H. Balston is in Brooklyn, New York; A. R. Thompson is in New York, N. Y.

X Q. 24. Have you ever worked in a chemical laboratory and there made a special study of chemistry elsewhere than at the New York University, as you have testified to?

A. I have prepared experiments for lectures in the medical department of the University of Georgetown; otherwise no.

X Q. 25. What was the extent of your work there?

118 A. Generating oxygen and other gases and preparing the apparatus to be used by the lecturer.

X Q. 26. I meant by my question, how long was your employment there?

A. One or two years.

X Q. 27. How long ago was that?

A. As near as I can recollect, it was 1876 or 1877.

X Q. 28. Can't you state whether it was one year or two?

A. I think it was two; cannot say positively.

X Q. 29. Who was the lecturer for whom you did this work?

A. B. S. Hedrick, of this city.

X Q. 30. Is he a relative of yours?

A. My father.

X Q. 31. When did you first hear of the complainant's patent involved in this suit?

A. When it issued.

X Q. 32. State the circumstances under which you then heard of it.

A. I was instrumental in procuring it, and therefore noted it when it issued.

X Q. 33. State what you did in procuring it.

A. I argued the matter before the Department as the representative of Mr. Pollok, who was the solicitor for the application.

X Q. 34. At all stages of the application?

A. Possibly not at all stages.

X Q. 35. State in detail, as far as you can remember, each step in the proceedings to obtain the patent in which you took part and specifically what you did.

A. So far as I recollect, I examined the references which were given by the Patent Office; I consulted with Mr. Pollok as to the pertinency of those references; I read the inventor's statements, and I presented to the Patent Office, as the result of consultations with Mr. Pollok, the points of difference and of novelty.

119 X Q. 36. How many times did you argue the matter of the application for the complainant's patent before the Department officials?

A. Several times. I cannot say precisely how many.

X Q. 37. Is it your belief that you argued it every time an argument was made there?

A. It is.

X Q. 38. Were you in Mr. Pollok's general employ at that time or were you specially employed for the particular services rendered in connection with that application, to which you have testified?

A. My employment was special in one way, but general in another.

X Q. 39. State in what way it was special and in what way it was general.

A. It was special in that I was not employed on a salary, and that I did not attend to all Mr. Pollok's cases, and general in that I did attend to a great many of his cases, and particularly to those involving chemical principles.

X Q. 40. Had you an office in Washington at the time you rendered the services spoken of in the application for complainant's patent?

A. I had the same as I have now.

X Q. 41. Which is where?

A. In this room.

X Q. 42. That is, with Mr. Pollok?

A. In one of Mr. Pollok's rooms.

X Q. 43. When you say you had and have an office do you mean that you rent one of your own or simply that you occupy a desk in Mr. Pollok's office?

A. I mean that I have my own business which I attend to there. There is no rent *eo nomine*.

X Q. 44. Then you do not hire an office yourself?

A. No.

X Q. 45. Is your name upon the door of any office?

120 A. It is not.

X Q. 46. When first did you make special examination of the authorities and subject testified to in your answer to question 6?

A. About two years ago, as I now recollect.

X Q. 47. Where and when has it been recently proposed to use hydrogen peroxide as a reagent in quantitative analysis?

A. In the "American Chemical Journal" for 1883 there is an article based upon foreign publications, in which the scheme is referred to.

X Q. 48. Who proposed to use it for bleaching cloth as early as 1878?

A. That use is referred to in Payen's Industrial Chemistry by Paul.

X Q. 49. Is that all you know about the proposition to use hydrogen peroxide for bleaching cloth as early as 1878?

A. Yes.

X Q. 50. State specifically what you mean when you say hydrogen peroxide consists of the same elements as water?

A. If you decompose water you will obtain hydrogen and oxygen. If you decompose hydrogen peroxide completely you will get hydrogen and oxygen.

X Q. 51. Will you get by such decomposition nothing but those two elements?

A. Nothing.

X Q. 52. In what proportion will you get those two elements in each case?

A. In water two volumes of hydrogen to one volume of oxygen, or by weight two parts of hydrogen to sixteen of oxygen. In hydrogen peroxide equal volumes of hydrogen and oxygen; by weight two parts of hydrogen to thirty-two parts of oxygen.

X Q. 53. In your answer to question 6 you state that the operation of making hydrogen peroxide can be shortened by cooling the vessel. Is not the direction to do that contained in all elementary chemical works with which you are familiar?

121 A. The statement is "by cooling * * * with a mixture of ice and salt." This mixture produces a lower temperature than ordinarily recommended.

X Q. 54. How do you know that fact?

A. The ordinary recommendations do not contemplate the use of a refrigerating mixture of such intensity as I know ice and salt to be, as well by experience as from statements in scientific works.

X Q. 55. Do you know what "the ordinary recommendations contemplate" beyond or aside from what is stated in the works themselves on that subject?

A. If the work stated that the chloride of barium remained in solution I should know that such a low temperature as would cause the crystallization of the said chloride was not contemplated.

X Q. 56. Do not most or all of the text-books on this subject state in substance and in general terms that the vessel containing the liquid mixture should be kept cool during the process of manufacturing hydrogen peroxide?

A. They do.

X Q. 57. Now, do you know what process of cooling is contemplated by these recommendations, aside from what is stated in the books themselves, in any individual instance?

A. No.

X Q. 58. You have stated in your testimony that the manufacture of hydrogen peroxide was a process of much difficulty prior to the complainant's alleged invention, and have cited some authorities bearing upon that point. Now, wherever any of the text-books cited or alluded to by you in such testimony speaks of the difficulty of the process, and wherever you speak of the same thing, is not chemically pure hydrogen peroxide or what is substantially so meant?

122 A. The production of a very concentrated hydrogen peroxide is much more difficult to manufacture than one of less concentration. Generally the very concentrated article is, no doubt, referred to, but not always. The same difficulties are encountered to a less degree in the manufacture of a more dilute article.

X Q. 59 What do you mean by a greater or less degree of concentration in hydrogen peroxide?

A. More or less admixture of water.

X Q. 60. That is, I understand, that the greater the concentration the less water and the less the concentration the more water?

A. Yes; the less or more water proportionately.

X Q. 61. Now, as water and hydrogen peroxide are composed of the same elements, can you explain the question of concentration more particularly by employing the terms of the chemical elements in giving the explanation?

A. While hydrogen peroxide is composed of the same elements as water, it is yet a different substance or chemical compound and is dissolved in the water which is present; it is a solution just as the ordinary acids of commerce are solutions. I do not understand how the employment of the terms of the chemical elements can assist the explanation.

X Q. 62. Are not the relative proportions of oxygen and hydrogen very different in concentrated hydrogen peroxide and in dilute hydrogen peroxide, or in what you call a solution of hydrogen peroxide?

A. The relative proportions of the oxygen and hydrogen in the chemical compound hydrogen peroxide are the same in all cases. Where a larger relative quantity of hydrogen peroxide is dissolved in the water a larger volume of oxygen can be obtained by decomposition of that quantity.

X Q. 63. If a solution contains, for instance, twenty per cent. of hydrogen peroxide and another solution contains forty per
123 cent. of hydrogen peroxide, what will be the relative proportions of hydrogen and oxygen in the two solutions?

A. Approximately, as there is double the quantity of hydrogen peroxide present in the forty per cent. solution, the quantity of oxygen in excess of what is contained in water would be double; consequently there would be a larger quantity of oxygen obtained by a complete decomposition of the solution.

X Q. 64. Then, as the degree of concentration increases, the proportion of oxygen becomes greater relatively to the proportion of hydrogen, does it not?

A. Yes; because hydrogen peroxide contains more oxygen proportionately than water.

X Q. 65. Now, is not the difficulty and the only difficulty in obtaining hydrogen peroxide of a high degree of concentration due to holding the requisite quantity of oxygen in the solution?

A. The principal difficulty is undoubtedly to prevent some of the hydrogen peroxide from decomposition—in a state of great concentration.

X Q. 66. Is there any great difficulty or have any of the text-books or works referring to chemistry intimated that there is any difficulty in obtaining a solution of hydrogen peroxide containing ten per cent. of hydrogen peroxide, so far as you know?

A. For chemical purposes there would be no very great difficulty in preparing a solution of that strength in small quantities. I do not know that the text-books refer specifically to such a solution.

X Q. 67. What do you understand text-books and articles on

chemistry generally to allude to when they speak of hydrogen peroxide—that is, what degree of concentration?

A. That could only be ascertained from the connection.

X Q. 68. Making such connection in the works and language cited by you on your direct examination, wherein the difficulty of making hydrogen peroxide is spoken of, what degree of concentration do you understand to be meant?

124

A. Referring to my answer to question 6, Thomsen I understand to be preparing a solution of moderate concentration. Wurtz in the paragraph quoted refers to the most concentrated, for it is expressly said that the oxygenated water is to be concentrated and pure. Berzelius, in speaking of Thenard's use of sulphuric acid, I understand to mean all stages of concentration—that is to say, he was never able to get more than a very dilute solution on account of the escape of the oxygen; the reference in Payen's Industrial Chemistry, in Wagner & Gautier's Chimie Industrielle, and in the Chemical Society Journal I understand to be to a solution of moderate concentration.

X Q. 69. What percentage of hydrogen peroxide in the solution do you mean when you use the phrase "moderate concentration?"

A. Three per cent. solution would be a moderate concentration, but, of course, the words include a less or greater degree of concentration.

X Q. 70. Do you mean three per cent. where you have used the expression "moderate concentration?"

A. Three per cent., more or less; it might be as high as ten per cent.

X Q. 71. Then, by moderate concentration, you wish to be understood as meaning anywhere from three to ten per cent.?

A. Yes.

X Q. 72. What percentage do you wish to be understood as meaning when you speak of a very dilute solution?

A. Say below three per cent.

X Q. 73. What do you call a high degree of concentration?

A. Above ten per cent. may be called a high degree.

X Q. 74. Why do you select these points of division as marking the limits of "very dilute," "moderate," and "high" degrees of concentration?

125

A. Many of the works refer to the use of three per cent. or thereabouts as useful for the purposes stated, and for that reason principally I selected that — a basis for a product of moderate concentration. Allowing a reasonable limit for the use of general terms, I fixed ten per cent. as a limit above which the concentration might be considered "high." I call the solutions above three per cent. "dilute" because below the point which I had fixed as being a "moderate" concentration.

X Q. 75. Is it your opinion that treatises or articles upon chemistry, where they speak of "dilute," "moderate," and "high" concentration, mean the same percentages of hydrogen peroxide in the solution that you have given as your meaning in the use of those terms?

A. The words are of general meaning and would be applied with a great deal of latitude; but if a standard is to be set, my opinion is that the amount given will answer as well as another.

X Q. 76. My question is if you think the use of those terms in standard and well-known authorities, such as you have spoken of in your direct examination, indicates about the same percentage that you have stated as your meaning?

A. Yes; unless from the context it could be gathered that a different meaning was intended.

X Q. 77. Are not the terms "dilute," "moderate," and "high" concentration ones that have a somewhat definitely recognized meaning among chemists, when used, of the degree of concentration of hydrogen peroxide in a solution?

A. So far as I am aware, they have no fixed and precise limits, but are applied just as they are to any solutions and all solutions.

X Q. 78. If you saw the phrase "high degree of concentra-
126 tion of hydrogen peroxide" used by a recognized chemical authority, would it convey to you no definite meaning as to the percentage of hydrogen peroxide in the solution?

A. I would understand that a relatively large proportion of hydrogen peroxide was dissolved.

X Q. 79. What percentage?

A. It would be impossible to give any precise percentage. It might refer to the almost pure hydrogen peroxide prepared by Thenard; but I would ordinarily understand a solution with considerably less hydrogen peroxide, say anywhere above ten per cent.

X Q. 80. If you call ten per cent. a high concentration what would you call twenty per cent.?

A. That would be a high concentration too, and if a comparison were intended it would be a higher degree of concentration.

X Q. 81. Then, by your terminology a high degree of concentration of hydrogen peroxide solution means anything from ten per cent. of hydrogen peroxide in the solution up to hydrogen peroxide in almost a pure state?

A. Yes.

X Q. 82. What are the purposes for which a dilute solution of hydrogen peroxide, as stated by you, are useful?

A. As medicine, cleaning old paintings, such as are tarnished by sulphurated hydrogen, and as a disinfectant.

X Q. 83. Do you know what is the degree of concentration of hydrogen peroxide as an article of merchandise at the present time?

A. Some of the journals state, according to my recollection, that a solution of two or three per cent. is an article of industry and commerce. I understand, from the testimony in this case, that solutions of from three to five per cent. are sold in this country.

X Q. 84. Is that all you know on the subject?

127 A. I know otherwise that it has been made and sold as a means of bleaching ladies' hair, but I have never ascertained the strength of the solution except as above stated.

X Q. 85. Is your present situation as to an office and your relations to Mr. Pollok the same as they were at the time the applica-

tion for complainant's patent was pending before the Department, and have they so continued from that time to the present?

A. Yes.

X Q. 86. How is hydrogen peroxide produced chemically?

A. It is produced by the decomposition of binoxide of barium with acid in the presence of water.

X Q. 87. How is that decomposition effected?

A. The barium unites with the radical of the acid in virtue of their chemical affinity and the oxygen of the binoxide of barium unites with the hydrogen set free.

X Q. 88. What, if anything, is done to aid the reaction after the binoxide of barium is added to the acid solution?

A. It is customary to cool the mixture and also to stir it.

X Q. 89. Are stirring and cooling spoken of in the earliest books describing hydrogen peroxide?

A. They are, so far as I have examined them.

X Q. 90. What is the object and purpose of the stirring?

A. To diffuse the binoxide of barium in the acid solution.

X Q. 91. Has stirring any other purpose, use, or benefit in the manufacture of hydrogen peroxide except to bring the particles of binoxide of barium in contact with fresh particles of the acid solution?

A. Yes; it prevents the hydrogen peroxide, when formed, from remaining in contact with the undecomposed particles of binoxide of barium, which would tend to liberate the oxygen.

128 X Q. 92. How does it do this?

A. The general explanation is that it is due to catalytic action, the nature of which is not understood. Theories have, however, been propounded to account for the action.

X Q. 93. What do you say is due to the catalytic action?

A. The decomposition of the hydrogen peroxide after it is formed by liberating oxygen.

X Q. 94. How does stirring prevent the catalytic action?

A. Its tendency is to prevent the hydrogen peroxide from remaining in contact with the particles of binoxide of barium.

X Q. 95. Can it do this otherwise than by bringing the particles of barium in contact with fresh particles of acid, so as to exhaust the barium by reaction producing more hydrogen peroxide?

A. When barium binoxide is decomposed by dilute acid the barium neutralizes the acidity at the places of contact. If there were no movement in the liquid instead of being acid at those places it would remain neutral or alkaline. This would render the peroxide of hydrogen more unstable than it would be were the acidity of the solution maintained. Moreover, at those points the solution of hydrogen peroxide would be much concentrated, which is further favorable to its decomposition. Thirdly, if there were no stirring the hydrogen peroxide would remain in contact with those materials, which, by their very presence (catalysis), produce its decomposition into water and oxygen gas.

X Q. 96. How does the stirring remedy or avoid these dangers?

A. The stirring tends to carry off the hydrogen peroxide and

mingles it with the solution, so that it is in a less concentrated form. It separates it more or less from the particles which are ready to effect its destruction, and it tends to restore continually the
129 acid nature of the liquid wherever it becomes neutralized by the reaction with the barium binoxide.

X Q. 97. Is not all this simply another way of stating that the motion in the liquid mixture caused by the stirring brings or tends to bring the particles of barium in contact with fresh particles of the acid, so that the particles of barium will be converted into hydrogen peroxide?

A. Undoubtedly the stirring has this effect or tends to have it, but that is not all, for then it would be immaterial how much binoxide of barium was in the solution at one time. Probably it was first resorted to to accomplish that effect, of bringing the particles of barium binoxide into contact with the particles of acid.

X Q. 98. Is the unfavorable presence which you have mentioned of the barium which has not reacted and of the neutralized particles of acid in contact with the hydrogen peroxide that has formed cured or avoided in any way by the motion in the liquid, except as that motion tends to and does bring the fresh particles of barium in contact with fresh or unneutralized particles of acid, so as to dispose of them by further reaction?

A. The disposal of the binoxide of barium by reaction with the acid would not prevent the disadvantages arising from its presence undecomposed, because it occurs later in time. Chemical reactions, like all other things, require time to bring them about, and where particles of a solid are introduced into a liquid it is necessary to produce a reaction first with the surface molecules of the solid particles, afterwards with the interior ones as they successively become surface molecules. It may be said, however, that the stirring which tends to bring the particles of binoxide of barium and of acid into contact tends also, in a greater or less degree, to avoid the difficulties named.

X Q. 99. Will you state exactly how stirring the liquid
130 overcomes the disadvantage of the neutralized acid and the particles of barium upon which the acid has not yet acted coming in contact with the hydrogen peroxide, except as they are disposed of by being brought in contact with fresh acid—that is, how else is such unfavorable contact prevented or ended?

A. The motion tends to diffuse the hydrogen peroxide equally throughout the liquid; nothing else seems to be necessary beyond what has already been said. I do not, however, pretend to state in detail everything that takes place in the manufacture of hydrogen peroxide, for doubtless there are many things which no one understands. I only mention some phenomena which I am satisfied do take place.

X Q. 100. Will you please state in detail all the beneficial effects of stirring the liquid in the process of manufacturing hydrogen peroxide, so far as they are definitely known to you, and state exactly how the motion caused by the stirring produces such effect?

A. The stirring, by bringing the particles of liquid successively

in contact with the walls, which are cooled, tends to maintain a uniform low temperature throughout the liquid; besides this, I do not think there is anything to add to previous answers.

X Q. 101. Please state again what are the dangers or unfavorable presences around the hydrogen peroxide as it first results from reaction in the process of manufacture.

A. First, rise of temperature, due to the combination of the barium with the acid; second, the existence of the peroxide of hydrogen in a state of approximate purity at those points where the reaction has just taken place; third, the absence of acid at that point (peroxide of hydrogen being more stable in an acid than in a neutral or alkaline solution); fourth, the presence, in contact with the per-

131 oxide of hydrogen, of the barium binoxide, including the impurities which the article as actually made and used contains.

X Q. 102. Are the third and fourth difficulties mentioned in your last answer anything more than explanations or reasons of the second difficulty you mentioned in the same answer?

A. Yes; they are.

X Q. 103. Then will you explain more fully the nature and causes of the second difficulty mentioned?

A. The nature is simply that when peroxide of hydrogen is formed it is of course first produced and then dissolved in the surrounding liquid, so that for a time it exists in a nearly pure state, or certainly in a very concentrated solution, and that in this form it is much more ready to part with its extra equivalent of oxygen than if it is mixed with or diffused through much water.

X Q. 104. What is the surrounding liquid at the moment of the formation of the hydrogen peroxide?

A. Dilute acid principally.

X Q. 105. Into what liquid does the motion take the hydrogen peroxide after its formation?

A. Dilute acid.

X Q. 106. By dilute acid, in these answers, do you mean the acid as first put in or as rendered dilute by the chemical reaction which forms the hydrogen peroxide?

A. The acid as it exists at the time of the reaction between the particular molecules. It would be the acid as originally put in at the beginning of an operation, but the acid considerably weakened in consequence of the reaction at the end of an operation.

X Q. 107. Has one method of stirring any advantage over another, so far as the hydrogen peroxide produced is concerned?

A. So far as the chemical compound called hydrogen peroxide is concerned there is none.

132 X Q. 108. Has the particular direction of motion produced by stirring in and of itself any virtue in the manufacture of hydrogen peroxide?

A. Some changes in direction would produce no difference; others might be highly advantageous.

X Q. 109. Would it make any difference whether the motion is from right to left instead of from left to right?

A. It would not, so far as I am aware.

X Q. 110. Would it make any difference if motion is downward instead of upward?

A. You cannot produce a downward motion without a corresponding upward motion in a body of liquid in a vessel.

X Q. 111. When there is both upward and downward motion in the liquid has the one more virtue than the other in the manufacture of hydrogen peroxide?

A. When the liquid, being dilute acid, is given an upward motion in one part of the vessel and a downward motion in the other the effect of the upward movement is to lift the solid particles and prevent them from settling at the bottom of the vessel. The downward motion is a necessary corollary of the upward. You cannot have one without the other.

X Q. 112. Question repeated.

A. If a distinction is to be drawn between two inseparable things the upward motion of the liquid has the greater virtue.

X Q. 113. What is it?

A. It tends to lift the solid particles and prevent their settling at the bottom of the vessel.

X Q. 114. Any other?

A. So far as I am aware, none, except what would follow from that action.

X Q. 115. What action?

A. The lifting of the solid particles.

X Q. 116. What is the virtue of lifting the particles of solid matter upward?

133 A. If there should be no upward movement the solid particles would remain at the bottom of the vessel. The same particles of liquid would also remain at the bottom of the vessel and in contact with the solid particles; thus the acid in those particles of the liquid would soon be neutralized and the liquid be rendered alkaline, the hydrogen peroxide formed by the decomposition would exist in that part of the liquid, and in contact with substances liable by their presence to decompose it; the lifting carries up the solid and liquid particles and causes a mixture of the same throughout the body of the liquid and constantly presents new particles of acid to act upon the binoxide of barium, maintaining the acidity in all parts of the liquid, diffusing the hydrogen peroxide as it is formed and preventing any particle of hydrogen peroxide remaining long in contact with the same solid particle.

X Q. 117. Is the chemical reaction more perfect when the motion is in an upward rather than in the downward direction, provided the condition of the acid and the diffusion of the barium in it is the same in both cases?

A. The direction of motion of the particles at the time of reaction would have, in my opinion, no effect, provided other conditions were the same.

X Q. 118. Are there any known means of manufacturing peroxide of hydrogen except mixing binoxide of barium with an acid?

A. You can use other metallic peroxides—such, for example, as

calcium binoxide, peroxide of potassium or sodium; it can also be formed by electrical action, or by the slow oxidation of phosphorus; but these would hardly be called manufacturing processes; in fact, the process of using barium is the only one of much utility.

X Q. 119. Is it your opinion that the complainant's alleged invention has added anything to what was previously known as to the ingredients or combinations of ingredients from which hydrogen peroxide can be obtained?

134 A. No.

X Q. 120. Then when you say, in your answer to question 9, that complainant's patent shows new means for the manufacture of peroxide of hydrogen, do you refer to anything more than the method of mixing the ingredients from which that article is produced?

A. No.

X Q. 121. Is not the ease or difficulty of keeping the binoxide of barium suspended in the liquid and preventing its falling to the bottom of the vessel greatly affected by the state of division of the barium—that is, by its being in more or less minute particles?

A. The more minute the division the easier it could be kept in suspension.

X Q. 122. Then does the specific gravity of the solid, as that phrase is ordinarily used, necessarily indicate the difficulty of keeping it suspended in a liquid of less specific gravity?

A. Yes.

X Q. 123. What is the specific gravity of gold?

A. It is very great. I don't recollect the precise number.

X Q. 124. Does the specific gravity of gold necessarily indicate the difficulty of keeping it suspended in water?

A. Yes, other conditions being equal.

X Q. 125. What other conditions affect the question?

A. I have already said that the state of division affects it.

X Q. 126. Cannot gold, the specific gravity of which is commonly said to be much greater than that of water, be easily suspended in water, and without difficulty?

A. It would be very difficult to suspend any considerable proportion of gold in water.

X Q. 127. Please answer without reference to proportions;

135 and my question is, cannot gold easily be suspended in water without the slightest danger of its falling to the bottom of the vessel?

A. No.

X Q. 128. Will not the gold leaf used by dentists float upon the surface of the water without difficulty?

A. If properly disposed—yes; so will an iron ship float upon the water.

X Q. 129. Is it the same cause that floats an iron ship and floats gold leaf used by dentists on the surface of water?

A. Yes; the water displaced is greater than the solid bulk of the material would be if it were in one solid, homogeneous mass or were divided into a number of such separate masses.

X Q. 130. Am I to understand by your statement in your direct examination that it is your opinion that the complainant's alleged invention consists in the directions of the motions which his apparatus is alleged to produce?

A. Yes; but I should say it was the motions rather than the directions.

X Q. 131. Then is it your opinion that the production of those motions by any agency would be an infringement of his patent?

(Objected to as incompetent.)

A. Yes; to give the same motions the agency must necessarily be substantially alike.

X Q. 132. If the same motions were produced by several men stirring the liquid with sticks, would this be an infringement of the complainant's patent?

(Objected to as incompetent.)

A. The same motions could not be produced by the means stated, and therefore the use of such means—that is, several men armed with sticks—would not be within the patent, in my opinion.

136 X Q. 133. Assume that precisely the same motions could be produced by several men using sticks to stir the liquid, would the production of such motions by that means be an infringement of complainant's patent, in your opinion?

(Objected to as incompetent and as already answered and as making an improper assumption.)

A. The assumption appears to me inadmissible. The use of such means would not infringe complainant's patent, in my opinion.

X Q. 134. I do not ask for your opinion as to the admissibility of the assumption. I say: Assume that precisely similar motions could be produced in that way, and then say as to whether the production of the motions in that way would be an infringement of the complainant's patent.

(Same objection.)

A. The use of such means would not infringe the patent.

Defendant gives notice that he will move to strike out all of this witness' direct testimony on the subject of the nature and scope of the complainant's alleged invention unless the last three questions are or one of them is answered, categorically, yes or no, on the ground that the answers given to those questions are designedly evasive and contumacious, and that the witness practically refuses to submit to cross-examination.

Complainant's counsel submits that the answers given have been fair and candid.

Witness desires to say that his object is to answer the questions fairly, fully, and frankly, but he does not think that he ought so to answer them as to misrepresent his opinion; that the an-

137 swers were given in the form adopted because it seemed to him from the framing of the question that simple "Yes" or

"No" would misrepresent him, the assumption seeming to witness to involve an absurdity. It being his opinion that the patent does not contemplate any kind of stirring with an ordinary stick or sticks in the hands of an operator or operators, witness has no hesitation, after this explanation, in answering no.

X Q. 135. Then, to repeat the substance of the last three questions, assuming that motions precisely the same as those claimed to be produced by complainant's apparatus can be produced by several men stirring with sticks, would the production of such motions by this means be an infringement of complainant's patent, in your opinion?

(Same objection.)

A. No.

X Q. 136. Then, since you say that in your opinion complainant's invention consists in production of the motions alleged to result from the use of the apparatus described by him, and yet that the production of such motions by several men stirring with a stick, if that can be done, would not be an infringement, where do you draw the line between the production of the motions and the means by which such motions may be produced?

A. While the patentee, so far as I am aware, was the first to discover that the motions therein referred to were useful in the manufacture of hydrogen peroxide, it is evident also that he did not contemplate the use of hand-stirring, as included within the patent, and that such stirring was not regarded by him as the equivalent of the mechanical stirrer described. The means of stirring
138 which are necessary to give the motions must evidently be substantially like or within the same category as the apparatus described.

X Q. 137. By the words "within the same category" do you mean stirring by any kind of mechanical apparatus?

A. Yes, provided it gave to the liquid the motions referred to.

X Q. 138. Am I to understand that it is your opinion that the complainant's alleged invention consists in discovering that the stirring necessary in the manufacture of hydrogen peroxide could be performed by mechanical apparatus instead of by hand?

A. No.

X Q. 139. Does it, then, consist in the production of certain alleged motions by means of any kind of mechanical apparatus, in your opinion?

A. Yes, provided the apparatus was not utterly unlike, so as to be in no sense an equivalent of that described.

X Q. 140. Do you consider yourself a mechanical expert?

A. Yes.

X Q. 141. What experience, studies, or other qualifications have you had to render you an expert on the subject of mechanical appliances and apparatus?

A. In college we had lectures upon the elements of mechanics and physics; since my graduation I have been engaged in the study

of various machines and the preparation of specifications describing them, and in explaining the differences in construction and operation of different classes of machines.

X Q. 142. Now, am I to understand you that it is your opinion as an expert that a "continuous movement of rotation, as well in vertical as in horizontal planes," producing "rotary or eddying movements" in a liquid cannot be produced by men stirring that liquid with sticks by hand?

139 A. My opinion is that while with ordinary stirring there might be a slight movement of the particles of liquid in vertical planes as well as round and round horizontally, the vertical rotation could not be compared to the rotary movements in vertical planes contemplated by the words quoted.

Defendant gives notice that he will move to strike out the whole of the last answer as not being responsive to the question and as being deliberately evasive of the question.

X Q. 143. Last preceding question repeated. I ask for no comparisons. I ask for a simple answer on a single question of fact.

(Objected to as already fully answered.)

A. The answer was intended to mean that the vertical movements which could be produced by ordinary stirring would not be a continuous movement of rotation in vertical planes, as those words are used in the quotation. With this explanation, I answer no to the question.

Notice of same motion with regard to this answer as to previous one.

X Q. 144. Is it your opinion as a mechanical expert that there is any novelty in the apparatus described in the specification of complainant's patent in and of itself, irrespective of the results produced by that apparatus?

A. No; except in some minor details.

X Q. 145. Specify any detail of the apparatus itself which you consider novel.

A. So far as I am aware, the matters pointed out in the second and succeeding claims of the patent are novel in and of themselves.

X Q. 146. I ask you to specify those details.

A. It is new to suspend a screw in a vessel so that it does
140 not touch the bottom, and to attach a disk to the shaft of said screw. It is new to make a detachable connection between the said screw-shaft and the shaft by which it is operated and from which it is suspended. The general combination of acid receptacle, the jacketing vessel, suspended screw, power shaft, and means for preventing dirt from falling into the vessel—that is to say, a disk on the screw shaft—is also new, so far as I am aware.

X Q. 147. Do you say that there never was a shaft moved by mechanical appliance suspended in a vessel so as not to touch the bottom, prior to the complainant's use thereof?

A. No; I do not assert it.

X Q. 148. Do you as a mechanical and patent expert think there is any novelty or invention involved in merely adding a screw to the lower end of a shaft thus suspended?

A. That would depend upon the results to be obtained. As a broad proposition, I should say not.

X Q. 149. Do you as a mechanical and patent expert consider that there is any novelty or invention involved in attaching a disk to the shaft descending into a vessel to keep dirt or other matter from falling into the vessel?

A. Yes; under proper circumstances.

X Q. 150. Do you mean to say, as a mechanical and patent expert, that you never saw or heard of a precisely similar use of a disk for the same purpose, and that you would be very much surprised to find that there was one in use fifty years ago, and that they have been constantly used from that time to the present for the same or a similar purpose?

A. I do not at present recollect of a precisely similar use. At the same time it is possible, as I have not made a thorough investigation of the subject, that such use might have existed. I would not be very much surprised if it were found to be so.

141 X Q. 151. Do you know what a dasher is in the most primitive and common form of a butter churn?

A. Yes.

X Q. 152. Is it not substantially a shaft to ply up and down in the body of the vessel of the churn?

A. No.

X Q. 153. What is it?

A. It is a rod provided with cross-pieces at the bottom projecting at right angles to the length of the rod, the latter passing through and guided by a hole in the cover.

X Q. 154. Is not its motion up and down in the process of churning?

A. Yes.

X Q. 155. Did you never see a disk attached to such a rod, above the cover through which it works?

A. It is possible, but I do not recollect it.

X Q. 155½. Would you not regard such a disk as substantially the same as that mentioned in the complainant's patent?

A. No.

X Q. 156. Am I to understand from your direct examination as to the manner in which you consider the apparatus used by defendant to be an infringement of complainant's patent to consist in the devices of the apparatus itself, any or all of them, irrespective of the motions produced in stirring the liquid by it?

A. No; it does not relate to the apparatus in and of itself, apart from the rotations in the liquid, in the manufacture of hydrogen peroxide, which it is used to effect?

X Q. 157. You have spoken in your direct examination of the use of a sand blast to engrave a plate. Is it your opinion that after the discovery of that use and its being patented it would be a new invention to apply a sand blast to clearing iron castings?

142 A. Offhand it would appear to me to be a different invention.

X Q. 158. Did you use the illustration of a sand blast without being familiar with the uses to which it has been put?

A. I have seen the sand blast operate to engrave and I am familiar in a general way with its use, but have not made a special study of the matter.

X Q. 159. Do you know anything of the state of the art on that subject as shown by the records of the Patent Office, across the street?

A. I have never examined the state of the art as contained in the records. My knowledge is derived from general reading, conversation, or experience.

X Q. 160. Do you make a specialty of patent law as a study and profession?

A. Yes.

X Q. 161. Do you not know that a patent for the application of the sand blast to cleaning iron castings has been adjudicated to be invalid on the express ground that it was an application of its use precisely analogous to its use in engraving, and therefore involved no novelty or invention, but was simply a new application of a well-known device?

A. No.

X Q. 162. You spoke in your direct examination of compound rotation produced by complainant's apparatus. Has such compound rotation any virtue in the manufacture of hydrogen peroxide, except to mix thoroughly the particles of the different ingredients and aid in keeping the barium from settling to the bottom of the vessel?

A. So far as I know, it has not, but I could not say positively that it had none.

X Q. 163. Is it your opinion as a mechanical expert that a greater variety of motions—that is, motions in a greater number of different directions at the same time, producing a greater number of
143 ever-changing eddies and currents and small whirlpools—cannot be produced by men stirring a liquid by hand with sticks than are produced by the use of complainant's apparatus as a stirrer?

A. Possibly a greater variety of motions could be produced by the men with sticks.

X Q. 164. Do you understand that the acid is in the liquid before the barium is put in and is put in all at one time at the outset of the process of manufacturing hydrogen peroxide? I am speaking now of the process as described in complainant's patent.

A. My recollection is that such is the case as described.

X Q. 165. Would it not make a material difference, in your opinion, if the acid solution were all put in at once at the outset instead of being added in small quantities from time to time, as and when the binoxide of barium is added—that is, would not the difficulties which you have spoken of as surrounding the hydrogen peroxide at

the moment of its formation in the process be more or less affected by this circumstance?

A. It would not make any material difference.

X Q. 166. Am I to understand from your answer to direct question 11 that the apparatus used by defendant infringes complainant's patent, if at all, only as to his first claim?

A. My opinion is that the first claim is infringed. The answer had reference to no other.

X Q. 167. I mean to ask if you wish to be understood as expressing the opinion that defendant's apparatus does not infringe anything except the first claim of complainant's patent.

A. I don't understand that the answer expresses such opinion; but, as far as I see, that would be my opinion.

X Q. 168. Is not the entire body of liquid carried continuously around and around in the vessel by the use of complainant's apparatus?

A. It is.

144 X Q. 169. Do you understand that the entire body of the liquid is carried continuously around and around by the use of the defendant's apparatus?

A. I do.

X Q. 170. Do you not understand that there are projecting into the vessel used by the defendants in their process boards four, five, or six inches wide and eight, ten, or twelve inches or more long that remain firm and immovable during the process?

A. I understand that there are such boards, though I do not recollect the precise dimensions given.

X Q. 171. Must not a large portion of the liquid strike against these boards in its rotary motion in such a way as to completely arrest that rotary motion?

A. No. Possibly some of it might be arrested for a short time.

X Q. 172. What do you understand those boards are put there for if it is not to impede the rotary motion suddenly after it has been developed?

A. I do not know for what purpose they are used. They certainly constitute obstructions to the liquid between the revolving blades and above the upper series of revolving blades.

X Q. 173. State your understanding of the arrangement of the stationary projecting boards and the revolving blades as used by the defendant.

A. At the bottom of the shaft there is a series of blades fixed to and revolving with the shaft. Above these blades there is a stationary blade attached to the wall of the vessel or a support thereon and projecting inward above the revolving blades. Above this stationary blade the shaft is provided with a second series of revolving blades, and above this series there is a stationary blade inwardly projecting from the wall of the vessel.

X Q. 174. If a particle of liquid in rapid rotary motion around and around the vessel comes in contact with one of these sta-

145 tionary boards at its center, assuming the width to be six

inches, what is the consequence, so far as the rotary motion of that particle is concerned?

A. The rotary movement horizontally would be checked.

X Q. 175. Would it not be completely arrested, so far as that particle is concerned, and require the application of a new force before it could proceed in the rotary horizontal direction?

A. Probably it would.

X Q. 176. And must it not start on an entirely new and independent motion in an entirely different direction before it can again proceed in the horizontal rotary direction and motion?

A. It would be carried along with the sweep of the current, and the direction of the motion would be temporarily altered before it again proceeds in the horizontal rotary direction and motion.

X Q. 177. Is there anything in the apparatus described in complainant's patent by which the rotary horizontal motion of the liquid is thus completely arrested and the particles absolutely turned in an entirely different direction?

A. There is not.

X Q. 178. Must not the angle made by the line of rotary horizontal motion and the line which marks the direction that a particle of liquid in such motion makes after striking one of the stationary blades in defendant's apparatus be at least an angle of forty-five degrees?

A. It might be less.

X Q. 179. Would you answer the same if my question assumed that the direction of the horizontal rotary motion was perpendicular to the face of the stationary blade?

A. Yes; for the particle of liquid might be carried over or under the stationary blade and continue at such an angle less than forty-five degrees.

X Q. 180. You say that the tendency of the centrifugal force of the liquid in horizontal rotary motion is to make the liquid
146 higher near the walls of the vessel than at the center. Would the production of this effect by centrifugal force alone, in your opinion, be patentable?

A. If I understand the question, no. The centrifugal force produced by hand stirring would cause the liquid to stand at a higher level at the walls of the vessel than at the center.

Adjourned at 10.50 p. m., Saturday, December 13th, subject to further notice.

PHILIP MAURO,
Notary Public.

147 WASHINGTON, *January* 20, 1885.

Met, pursuant to notice annexed, at 635 F street, at 11 o'clock, and thereupon the redirect examination of CHARLES J. HEDRICK is proceeded with.

R. D. Q. 181. Referring to cross-questions 69 to 81, inclusive, you were asked what you meant by "moderate concentration," and you said that from three to ten per cent. would be a moderate concen-

tration, but that the words "dilute," "moderate," and "high concentration" in treatises and articles on chemistry were words of general meaning and would be applied with a good deal of latitude. Now, will you please state whether there is any difference in the application of the adjectives mentioned between hydrogen peroxide referred to as an industrial product and hydrogen peroxide referred to as a product of the laboratory?

A. In many of the treatises on the subject it is plain from the context that when the hydrogen peroxide is referred to it is spoken of as a product of the laboratory, having qualities that make it very interesting to the chemical expert. When spoken of in this connection the terms "moderate" and "high" concentration would generally mean a higher concentration than would be meant if the same terms were used in connection with hydrogen peroxide as an industrial product.

R. D. Q. 182. What relation to each other do the percentage of hydrogen peroxide in aqueous solution and its volume of capacity bear?

A. The term "per cent. solution" is not very exact. If the percentage be estimated by weight one per cent. is equal to a little more than three volumes solution. If the percentage be by measure the volume capacity would be nearly half as large again, say about four and one-half volume capacity. A solution of one per cent. by weight would be where one pound of hydrogen peroxide
148 is mixed with ninety-nine pounds of water, or in that proportion. A gallon of such a solution would give off, if the hydrogen peroxide be completely decomposed, somewhat more than three gallons of oxygen gas measured under the standard conditions of temperature and pressure. A solution of one per cent. by measure would contain one pint of hydrogen peroxide, with enough water to make one hundred pints of solution, or in that proportion. A gallon of an aqueous solution of one per cent. by measure would give off (if the hydrogen peroxide be completely decomposed) about four and one-half volumes of oxygen gas under the standard conditions. In my previous answers, where I have used the term "per cent. solution," I would be understood as meaning by weight.

R. D. Q. 183. Now, as an industrial product, what was considered a high degree of concentration of hydrogen peroxide prior to the time that Mr. Marchand began to make it otherwise than by hand stirring?

A. I understand from the evidence in this case that the customary strength of the commercial peroxide of hydrogen was of ten volumes capacity or less (3.04 % or less by weight), although a higher concentration of twelve volumes was also made.

The authorities which I have examined are to the effect that the commercial article was of ten volumes capacity or less. In one instance it is said that the solution ordinarily used for bleaching hair was a ten-volume solution, and that a solution sold for bleaching ivory contained 2.9 % of rather crude hydrogen peroxide. In the extracts from Wurtz (p. 1200), speaking of its use in restoring designs and oil paintings, it mentions a design of Raphael cleaned with

a solution of five or six volumes concentration. In "Payen's Industrial Chemistry" (1878, p. 37), in speaking of its uses, it
149 says that the blackened colors of oil paintings have been restored by a solution containing only two per cent., by measure, of hydrogen peroxide, and in the next sentence it says that it might be used to advantage for cloth bleaching if it were cheaper, ten volumes (three per cent. by weight) or less being the standard strength. A greater degree of concentration would naturally be considered "high," and even a ten-volume solution might be so called if a distinction were to be drawn between it and a more dilute article.

R. D. Q. 184. Several of the extracts that have been offered in evidence describe the method of making hydrogen peroxide in a solution of water and then the separating of the water from the peroxide of hydrogen so as to make the latter nearly pure or very highly concentrated. Is there any suggestion that the last portion of the process can be performed and make the product in quantities sufficient for industrial use?

A. There is no suggestion that anything more than a small amount could be produced. All the processes which are described as producing anything like pure peroxide of hydrogen are most difficult and involve the productions of but a very small quantity.

R. D. Q. 185. Referring to the extract from Watts (1881), Vol. 8, p. 1072, he describes how hydrogen peroxide can be prepared in considerable quantities following the method of Thomsen. Will you please state whether that refers to the preparation of peroxide of hydrogen for industrial uses or for laboratory uses?

A. It is probable that he refers to both uses; but it is clear that he is describing the manufacture of a solution of hydrogen peroxide and not the pure article free from water. It also appears from the reference to the preparation in "considerable quantities" that the article to be made is designed for practical use and not as itself an object of investigation, study, or curiosity.

150 R. D. Q. 186. In your answers to questions 68 to 81, inclusive, reference is made to the terms "dilute concentration," "moderate concentration," and "high concentration," and you were asked what you meant by the terms. Will you please state whether this subject had been called to your attention with the view of limiting the terms referred to prior to the time that those questions were asked?

A. It had not. Prior to answer to cross-question 68 the only references that I made to the degree of concentration were in my answer to question 6, at fol. 316 of the print, where I said that in a very dilute solution peroxide of hydrogen was less unstable than in a more concentrated one, and in the same answer, at fol. 317 of the print, I stated that the methods of Pelouze and Duprez were recommended only when dilute solutions were to be made.

R. D. Q. 187. You have said to-day that the expressions "high concentration" and "moderate concentration" would have different meanings when applied to peroxide of hydrogen as an article of commerce and when applied to it as a laboratory product. Now,

bearing in mind this distinction, is there anything that you wish to correct in your answers to cross-questions 68 to 81, when you undertake to define degrees of concentration?

A. As I said in my answers to cross-questions 75 to 77, the words have no fixed and precise limitation. They are words of general meaning and would be applied with a good deal of latitude. I do not know that I could improve upon the answers already given to the questions referred to. The terms necessary must be very flexible, as all words of relation and comparison are. A most common example of this is the use of the words rich and poor. A man
151 considered rich in one section of the country or at one time would be considered poor in another.

R. D. Q. 188. When speaking of peroxide of hydrogen as an industrial product, what would you consider a moderate degree of concentration and what a high degree?

A. That would depend upon what degrees of concentration the commercial article had. If, then, it were sold in several degrees of concentration the richest in hydrogen peroxide would naturally be called of high concentration and the intermediate grades of moderate concentration. From the evidence and authorities I understand that the standard commercial article was formerly of ten volume-capacity or less, and from the evidence that it is now made of fifteen-volume capacity; that it is also made in considerable quantities of twenty-volume capacity, and has for special purposes been made of twenty-five-volume capacity. Under these circumstances the term high concentration would be applied to the twenty and twenty-five volume solutions, and the term moderate to the fifteen-volume, or possibly to the ten and fifteen volume solutions, if there were articles of still lower concentration in the market.

R. D. Q. 189. Now, you have said that the method described by Thomsen was adapted to the preparation of hydrogen peroxide as an useful product, and that you understand Thomsen was preparing a solution of moderate concentration, but, of course, the words included a less or greater degree of concentration. You also said (X Q. 70) that when you used the expression "moderate concentration" it meant three per cent., more or less, and might be as high as 10 per cent. Now, please state what degree of concentration you mean when you use the expression "a solution of moderate concentration," as applied to Thomsen's preparation.

152 A. The exact concentration which can be obtained by him is not stated, but, according to theoretical calculation, if he uses what he indicates as the strongest acid solution (1 part by weight $H_2 S O_4$ to 5 parts $H_2 O$) and should neutralize the sulphuric acid completely and perfectly, and should, moreover, have no loss of oxygen in the operation, he ought to obtain a solution containing about six per cent. by weight of hydrogen peroxide. As, however, he expressly avoids neutralizing the whole of the acid, it would be less. It is probable, also, that there would be some loss of oxygen, although not so much as if the more impure commercial binoxide were employed; and it is also probable that the full acid strength would not always be employed; three to five per cent.

would be fair statement of what he would obtain by his process. Of course, this product could be concentrated to any strength required under the vacuum pump or over sulphuric acid by evaporating off the water until the required degree of concentration is obtained.

R. D. Q. 190. In your answer to question 11 you stated that the centrifugal force obtained by the rotary motion in both the complainant's and in the Emken apparatus would cause the liquid to rise along the inside wall of the vessel and then descend in the center, thus giving rotation in vertical planes, and that this vertical rotation would be assisted in the complainant's apparatus by the inclination of the blades, and in the Emken apparatus by the stationary blades E (D. R., fol. 339). In your answers to cross-questions 171 and 172 you said, in answer to an inquiry whether or not a large portion of the liquid strikes against certain stationary boards in the Emken apparatus in its rotary motion in such a way as to completely arrest that motion, that it does not; that possibly some portion of the liquid might be arrested for a short time, and that you do not know for what purpose those boards are put there;
153 now, state whether or not the boards are the same thing as the stationary blades E.

A. The boards referred to in answer to the cross-questions are the stationary blades E of my answer to question 11 (fol. 339). In saying that "I do not know for what purpose they were to be used" I meant that I did not know the purpose of the defendant in using the stationary blades. To make my meaning clear, I added that "they certainly constitute obstructions," thus distinguishing the "purpose" of the defendant in using a certain thing from the effects which the thing actually had when used. Of the "purpose" I knew nothing, not being able to read the defendant's mind; the effect is very easy to understand.

R. D. Q. 191. Will you please state what, in your opinion, are the functions of the boards E, and also of the board F?

A. The piece of wood F is fastened to the side of the tub, and the boards E are fastened to it. These boards or stationary blades E, acting as obstructions, check the horizontal rotation of the liquid in the zones in which they are placed, and thus diminish the centrifugal force of the particles in those zones, as stated at folio 340 of my direct examination; they consequently assist in creating a vertical rotation of the liquid. I should, perhaps, in my answer to Q. 6 have also referred to the effect which an obstruction has in a current in banking up the liquid behind it. If there is a rock, for example, in the bed of a running river, when the water meets the rock it rises, and if the rock be not too high above the normal level it pours over the rock. The faster the current the higher the water will rise. In Emken's apparatus the boards or stationary blades E have the same effect—they bank up the liquid. The liquid which meets the lower blade, E_{22}, will pass—some of it inward towards the center, some of it will go under the blade E, but most of it
154 will go upward into the zone of the upper rotating blades, C, whence it will be forced into the zone of the upper board, E. The liquid on striking the lower board, E, will go upward rather

than downward, because the liquid above can be lifted, but the liquid below is confined by the sides and bottom of the tub. The effect of the boards banking up the current will be most preceptible at the upper board, E, from the rise which must take place at the surface of the liquid in consequence of said board or obstruction E.

As the particles of liquid have the greatest velocity at or near the periphery of the tub, the liquid rises highest there; consequently the tendency of the liquid to run from the periphery towards the center over the underlying liquid is increased and the vertical rotation of the liquid is made more energetic. The piece of wood F also acts as an obstruction and tends to increase the vertical rotation in the liquid, so far as its effect is felt. As the liquid would rise highest at the periphery of the tub adjacent to the upper board, E, and its support, F, the greater rush of liquid toward the center would be from that point.

Although this apparatus is probably not so good as the complainant's, in which there is an uniform rush of water towards the center from all parts of the circumference, it does the same thing with a greater intensity at one portion of the circumference.

Of course, motions would be imparted to small portions of the liquid besides the principal motions already described. Many of these motions would be movements in vertical rotation as well as horizontal, although their movement would be more confined.

R. D. Q. 192. In your answer to questions 111–113 you have spoken of the tendency of the upward movement in the liquid "to lift the solid particles and prevent them settling at the bottom of the vessel," and in your last answer you have said that in defendant's apparatus this upward motion which you have explained takes place at the periphery of the tub, is caused or assisted by the boards E and their support F. Is there a similar upward movement in the complainant's patented apparatus; and, if so, what causes it?

A. There is the same upward movement at the periphery of the tub or containing vessel. It is caused partly by the difference in the centrifugal force of particles in the top and bottom of the vessel, partly by the upward slope of the bottom of the vessel from the center towards the circumference, and partly by the inclination of the blades. If the screw be revolved in one direction, so that the upper edges of the blades are in advance, the inclined front faces of the blades will tend to force the liquid down, and, as it is confined by the bottom of the vessel, the pressure forces it outward and upward. If it be revolved in the other direction the opposite faces will now be in front and will tend to lift the liquid. In either case the inclination of the blade would assist in producing a vertical relation to the liquid.

R. D. Q. 193. In your answer to X Q. 111 you say "The downward motion is a necessary corollary of the upward." In what part of the vessel does this downward motion take place?

A. It takes place in the center, both in defendant's and in the patented apparatus. The upward movement at the periphery of the

vessel or tub and the downward motion at the center, in connection with the outward motion at the bottom of the liquid and inward motion at the top, constitute the vertical rotation or rotation in vertical planes, of which so much has been said.

R. D. Q. 194. In your answer to cross-question 162 you said that, so far as you were aware, the compound rotation had no virtue except to mix thoroughly the ingredients and aid in keeping
156 the barium from settling. Will you please say whether this answer is a full statement on the subject?

A. In my previous answer to X Q. 116 I had stated at some length the virtue which the continuous lifting of the barium binoxide to prevent it from settling would have in the manufacture of hydrogen peroxide. In connection with the previous answers it would, I think, appear that the facilitating the reaction between the acid and the binoxide of barium, the preventing of the loss of oxygen by decomposition of hydrogen peroxide when formed, and the enabling of hydrogen peroxide to be made in bulk were intended as virtues which follow the thorough admixture of ingredients and the prevention of the binoxide of barium from settling by means of the compound rotation. Thus understood, with the limitation on our knowledge as to what may take place expressed in the answer and previously referred to in answer to X Q. 99, the statement appears to be as full as I can make it.

R. D. Q. 195. In answer to X Q. 66 you say there would be no very great difficulty in preparing a solution of ten per cent. in small quantities. What do you mean by "very great difficulty?"

A. What I meant was that the chemist, having only a very small quantity of liquid to deal with and using the well-known precautions, would probably not lose enough oxygen as gas to render the operation of making a solution containing ten per cent. hydrogen peroxide by weight one of very great difficulty or uncertainty. I did not intend that the precautions usually recommended would be omitted or that the operation of making the solution would be effected in a short time. At that time, however, I had not examined the question of that percentage of hydrogen peroxide the solutions made by different processes would produce. The difficulty is probably greater than would appear from the answer. In
157 making hydrogen peroxide by Thénard's method, as described in Watts, a stop is made to the decomposition of binoxide of barium with hydrochloric acid when the solution is about twenty-five to thirty volumes capacity. This would correspond to a solution containing from a little less than eight to a little more than nine per cent. by weight of hydrogen peroxide. It would seem, therefore, that the difficulties, notwithstanding all his precautions, were considerable or the decomposition of binoxide of barium by hydrochloric acid would have been continued until a higher degree of concentration was secured.

Moreover, what might not be considered very great difficulties in the preparation of a chemical compound as an object of study or curiosity or for special purposes, where cost could hardly be an object, would

be an insuperable obstacle to its manufacture for industrial purposes, when the cost is often the controlling circumstance.

Adjourned subject to notice.

PHILIP MAURO, *Notary.*

WASHINGTON. *Feb.* 10, 1885.

A letter signed by Marshall P. Stafford, def'ts' solicitor, dated 7th of February, 1885, stating that he does not desire to further cross-examine the witness, and that his deposition may be closed, having been exhibited to the notary, the said witness reads his deposition and signs the same.

CHAS. J. HEDRICK.

Subscribed and sworn to before me this 10th day of February, 1885.

PHILIP MAURO,
Notary Public.

158 COMPLAINANT'S EXHIBIT EXTRACTS FROM SCIENTIFIC WORKS.

Dec. 8, 1884.
[SEAL.] P. M., *Notary Public.*

Berzelius. Traité de Chimie. Paris, 1845. Vol. I, p. 428.

"Cette liqueur blanchit et detruit toutes les couleurs végétales."
This liquid bleaches and destroys all vegetable colors.

Same, Vol. 1., p. 430.

"L'opération serait bien plus courte si on traitait le suroxyde barytique par l'acide sulphurique. Mais Thenard á reconu que, dans ce cas, la plus grande partie de l'oxygéne s'échappe sous forme gazeuse. C'est ce qui explique le long détour qu'on est obligé de faire pour préparer le suroxyde hydrique."

(Translation.)

The operation will be made shorter if the barium peroxide be treated with sulphuric acid. But Thénard has recognized that in this case the larger part of the oxygen escapes in the form of gas. It is this which explains the long detour which it is necessary to make in order to prepare peroxide of hydrogen.

159 Elements of Chemistry. Miller. London, 1868. Part 2, p. 257 *et seq.*

(485.) Peroxide of hydrogen; hydric dioxide or hydroxl ($H_2 O_2$ = 34); Sp. Gr. of liquid, 1,453.

Water is not the only compound of oxygen with hydrogen. Thénard, in the year 1818, discovered a remarkable substance, which, as it contains two atoms of oxygen in combination with two

atoms of hydrogen, is termed peroxide of hydrogen. It is a colourless liquid of syrupy consistence, with an odour somewhat resembling that of chlorine very much diluted. It remains liquid at a temperature of—22° (—30° C.). This peroxide is a very unstable compound. A temperature of about 68° (20° C.) is sufficient to cause the oxygen to begin to escape in small bubbles, and when heated to the boiling point of water the gas is evolved with a rapidity almost amounting to an explosion. The liquid is soluble in water in all proportions; when diluted it is less easily destroyed by elevation of temperature, though ebullition for a few minutes is sufficient to expel the whole of the additional atom of oxygen, water alone remaining.

Same, p. 258.

Hydric dioxide bleaches a solution of litmus and many vegetable colours. A drop of it if placed on the tongue blanches it and destroys sensation for a time. The taste of the liquid is astringent and somewhat metallic.

* * * * * * *

Hydric peroxide, however, is not only decomposed by substances which possess an attraction for oxygen, but the mere contact of many finely-divided metals and metallic oxides which do not undergo any permanent change occasions its decomposition. Gold, silver, and platinum produce an instantaneous evolution of oxygen gas, which is the more rapid the finer the subdivision of the body by which the decomposition is occasioned. A similar effect is produced by contact with the oxides of these metals or with the peroxide of manganese or of lead.

* * * * * * *

Same, p. 258.

Preparation.—Owing to the unstable character of hydric peroxide its preparation in a pure state is attended with great difficulty, although in principle the process is simple. An indirect method is resorted to for procuring it. Caustic baryta (Ba O), when heated to dull redness in a current of oxygen gas, combines with an additional atom of oxygen and becomes baric dioxide (Ba O_2); when this substance is moistened with water it forms a hydrate (Ba O_2, 6 H_2 O). Hydric peroxide is obtained from this hydrated compound by decomposing it by means of hydrochloric acid.

* * * * * * *

Same, foot-note, p. 259.

Pelouze substitutes silicofluoric for hydrochloric acid in decomposing the baric dioxide. It shortens the operation by removing the barium at once in the form of an insoluble baric silicofluoride. Baric dioxide may also be decomposed by suspending it in water and transmitting a current of carbonic anhydride, but the solution so obtained is dilute.

Fowne's Elementary Chemistry. Bridges. Philadelphia, 1878. Page 148.

161 Hydrogen dioxide, $H_2 O_2$, sometimes called oxygenated water, is an exceedingly interesting substance, but very difficult of preparation. It is formed by dissolving barium dioxide in dilute hydrochloric acid carefully cooled by ice and then precipitating the barium by sulphuric acid. The excess of oxygen of the dioxide, instead of being disengaged as gas, unites with a portion of the water and converts it into hydrogen dioxide. This treatment is repeated with the same solution and fresh portions of the barium dioxide until a considerable quantity of the latter has been consumed and a corresponding amount of hydrogen dioxide formed. The liquid yet contains hydrochloric acid, to get rid of which it is treated in succession with silver sulphate and baryta water. The whole process requires the utmost care and attention. The barium dioxide itself is prepared by exposing pure baryta, contained in a red-hot porcelain tube, to a stream of oxygen. The solution of hydrogen dioxide may be concentrated under the air-pump receiver until it acquires a specific gravity of 1.45. In this state it represents the aspect of a colorless, transparent, inodorous liquid, possessing remarkable bleaching powers. It is very prone to decomposition. The least elevation of temperature causes effervescence, due to the escape of oxygen gas; near 100° C. it is decomposed with explosive violence. Hydrogen dioxide contains exactly twice as much oxygen as water, or 16 parts to 1 part of hydrogen.

Watts' Dictionary of Chemistry. London, 1875. Vol. 3, p. 196.

Dioxide or peroxide of hydrogen. H O or $H_2 O_2$.

This remarkable compound was discovered by Thénard (Traité de Chimie, 4me. éd. iv., 2, 41). It is produced when peroxide of
162 potassium, sodium, barium, strontium, or calcium is digested in any acid which forms a soluble salt with the base resulting from the decomposition of the peroxide, the excess of oxygen not escaping as a gas, but passing over to a portion of the water, and converting it into the peroxide of hydrogen—*e. g.*,

$$Ba O + H Cl = 2 Ba Cl + H O.$$

Preparation.—Pure baryta is prepared by igniting in a porcelain retort nitrate of barium free from iron and manganese. The baryta, broken into pieces about the size of a nut, is then put into a coated glass tube and heated to low redness, while a current of oxygen gas free from carbonic acid and dried by means of quicklime is passed over it. For the first eight minutes the gas is eagerly absorbed by the baryta. After it has begun to escape from the farther end of the tube, to which a gas-delivery tube passing under water is fitted, the stream is still kept up for the space of ten or fifteen minutes. The peroxide of barium obtained by this process is, after cooling, preserved in a bottle. In the next place, 200 grms. of water are

mixed with as much hydrochloric acid as will neutralize about 15 grms. of baryta. Into this liquid, contained in a cylinder or, better, in a dish of silver or platinum, kept cool by surrounding it with ice, 12 grms. of peroxide of barium slightly moistened and rubbed up in an agate mortar are introduced by means of wooden spatula. On agitating or stirring the liquid with the pestle the whole dissolves completely and without effervescence. The baryta is next precipitated by sulphuric aid, added drop by drop till slightly in excess. The presence of an excess of the acid may be known by the sulphate of barium falling down more quickly than before. Twelve grms. more of the peroxide are then dissolved in the same liquid and likewise precipitated by sulphuric acid. The liquid, which

163 now contains hydrochloric acid, sulphuric acid, a large quantity of water, and a small quantity of peroxide of hydrogen, is next separated by filtration from the sulphate of barium, the precipitate washed with a little water, and the last wash water retained for future washings. The filtrate is again mixed as above, twice with peroxide of barium and twice with sulphuric acid. The filtration is then repeated and the process continued in the same way till 90 or 100 grms. of the peroxide are consumed. The liquid thus obtained would, on decomposition, yield from 25 to 30 measures of oxygen gas. To separate silica, alumina, sesquioxide of iron, sesquioxide of manganese, &c., which proceed from the porcelain retort in which the nitrate of baryta was ignited, the liquid is mixed with concentrated solution of phosphoric acid (2 or 3 pts. of phosphoric acid to 100 pts. of peroxide of barium), then surrounded with ice, and supersaturated with pounded peroxide of barium. Silica and the phosphates of iron, manganese, and aluminium then separate rapidly in flakes, and must be separated from the liquid by filtration through linen, and, if necessary, through paper. The presence of a large quantity of sulphate of barium renders the filtration difficult. (If no phosphoric acid were present the sesquioxide of iron and manganese would fall down by themselves and give rise to a rapid evolution of oxygen gas, but when they are mixed with phosphoric acid they do not produce this effect.) Should the liquid still contain portions of these oxides they must be separated by the addition of a slight excess of baryta water, whereupon the liquid must be immediately and rapidly filtered through several filters at once and the filters squeezed between linen to get all out. The whole of the baryta must then be separated by carefully adding sulphuric acid in very slight excess and filtering.

164 The filtrate now contains nothing but water, peroxide of hydrogen, hydrochloric acid, and a very little sulphuric acid. To separate the hydrochloric acid the liquid is surrounded with ice and mixed with sulphate of silver. In the first place, sulphate of silver, obtained by heating nitrate of silver in contact with oil of vitriol in a platinum crucible, is introduced in the form of powder into the liquid, the whole being constantly stirred till the liquid becomes clear, a sign that the hydrochloric acid is wholly or nearly precipitated. Any hydrochloric acid that may still remain must be separated by cautiously adding more sulphate of silver. If the latter

has been added in excess it must be precipitated by carefully dropping in a dilute solution of chloride of barium. The liquid should contain neither hydrochloric acid nor silver, and should therefore give no precipitate either with solution of silver or with hydrochloric acid. The chloride of silver is separated by filtration and pressure, any portion of liquid which comes through turpid being filtered again. To remove the sulphuric acid also and obtain a pure mixture of water and peroxide of hydrogen the liquid is placed in a glass mortar surrounded with ice and rubbed up with slaked baryta previously pounded and diffused through water. The baryta is added till the sulphuric acid is very nearly saturated. The liquid is then filtered, the filter pressed between linen, and baryta water added in slight excess. This often occasions the precipitation of oxide of iron and oxide of manganese, as well as sulphate of barium. Hence, the filtration must be rapidly performed. The excess of baryta is removed by cautiously adding dilute sulphuric acid, so that there may be rather a very slight excess of the acid than of the baryta. The whole of the sulphuric acid may likewise be removed by means of carbonate of barium obtained in a finely divided state by precipitating, instead of by slacked baryta and baryta water.

165 Finally, to separate the whole or nearly the whole of the water, the vessel containing the liquid is placed in a dish containing oil of vitriol and the whole placed under the receiver of the air-pump. The water then evaporates before the peroxide of hydrogen. The fluid is agitated from time to time. If it should deposit flakes of silica, which give rise to the escape of oxygen gas, it must be decanted off from them by means of a siphon. If it should evolve oxygen, which it will do as soon as it is so far concentrated as to contain about 250 times its volume of oxygen, two or three drops of sulphuric acid must be added to it. The concentration must be stopped after a few days, when the liquid is brought to such a state that when decomposed it would evolve 475 volumes of oxygen gas, for this residue, if left longer *in vacuo*, would evaporate as a whole. The peroxide of hydrogen must be kept in long glass tubes closed with stoppers and surrounded with ice; but even under these circumstances it decomposes slowly and evolves oxygen gas. (Thénard.)

2. Peroxide of barium is decomposed by hydrated hydrofluoric acid or solution of hydrofluosilicic acid, the whole being kept constantly cool. In this case insoluble fluoride of barium or double fluoride of silicium and barium separates at once. As soon as sufficient quantities of acid and peroxide of barium have been mixed the peroxide of hydrogen, still containing a large quantity of water, is filtered from the precipitate and concentrated *in vacuo* over oil of vitriol. (Pelouze, Berz. Lehrb., i, 411.)

Properties.—Colourless, transparent liquid, of specific gravity 1.452. It does not freeze at 30°; evaporates *in vacuo* at ordinary temperatures without decomposition, though much less readily

166 than water; does not redden litmus paper, but gradually bleaches both litmus and turmeric paper; has a harsh, bitter taste, similar to that of tartar emetic; whitens the tongue and thickens

the saliva. When placed upon the hand it instantly turns the cuticle white, and after a time produces violent itching (Thénard). Peroxide of hydrogen is miscible in all portions with water, part of the water freezing out on exposure to cold. A solution containing eight times its own volume of oxygen gas begins to evolve gas at 50° and subsequently gets into a state of violent ebullition, and when this has ceased nothing is left but water. The peroxide likewise unites with acids—*e. g.*, phosphoric, sulphuric, hydrochloric, nitric acid, &c.—forming mixtures in which it is less easily decomposed than when alone.

It is doubtful whether peroxide of hydrogen has ever been obtained quite free from water. Thénard, however, found, in a specimen prepared as above described, 6.02 per cent. hydrogen and 93.98 oxygen, the formula, H O, requiring 5.88 H and 94.12 O.

Decompositions.—The second atom of oxygen is retained by the hydrogen very loosely. Under various and often enigmatical circumstances it separates from the water in the form of gas, the volume of which at 14° and 0.76m. bar. (29.8 inches) amounts to 475 times that of the liquid. The gas often escapes with such rapidity as to produce violent effervescence and even explosion. Great heat is also developed, and when the experiment is made in the dark even light is apparent. * * *

(*a.*) Peroxide of hydrogen, whether pure or in aqueous solution, acts as a powerful oxidizing agent. * * *

(*b.*) Certain bodies, among which are included charcoal,
167 many metals, and some metallic oxides, induce, by their mere contact, a more or less violent decomposition of the peroxide into water and oxygen without themselves undergoing any change. Gold, platinum, and silver, particularly when in the precipitated or spongy state, act most violently and cause a great disengagement of heat. A slight acid solution of the peroxide is less amenable to the action of these agents than is the pure aqueous solution. Alkalies, on the other hand, facilitate the decomposition. The action of the above-mentioned bodies in causing the decomposition of the peroxide is termed catalytic. Its nature, however, is not at present understood.

Watts' Dictionary of Chemistry, Vol. VI or 1st supplement, p. 720. London, 1879.

10. The peroxides of potassium, sodium, and barium are resolved by water into hydrates of the alkali metal and hydrogen dioxide, which, however, is immediately decomposed by the alkali, and can therefore be detected in the solution only in a small quantity. On the other hand, it may be supposed that the alkaline hydrates are converted by hydrogen dioxide into hydrated peroxides, which are again resolved, with evolution of oxygen, into alkali hydrate, oxygen, and water; thus:

$$2\,K\,H\,O + 2\,H_2O_2 = 2\,K\,H\,O^2 + 2\,H_2O$$

and

$$2\,K\,H\,O_2 = 2\,K\,H\,O + O_2.$$

The rapid decomposition of hydrogen dioxide in all reactions in which alkalies are set free takes place in this manner, and is not due to catalytic action (Weltzien).

168 Watts, Vol. VIII (3d supplement). London, 1881. Page 1072.

Preparation.—For preparing hydrogen dioxide in considerable quantity the following method is given by J. Thomsen (Ber., VII, 73):

Finely divided barium peroxide, or the commercial (so called) hydrate, is dissolved nearly to neutralization in dilute hydrochloric acid, and to the filtered and cooled solution baryta water is added in quantity sufficient to throw down the foreign oxides and silica present and to produce a slight precipitate of hydrated barium peroxide. The solution is then filtered and mixed with concentrated baryta water, whereby crystalline hydrated barium peroxide is thrown down, which in the moist state may be kept for a long time in closed vessels without decomposing. To prepare hydrogen dioxide this moist hydrate is added, with stirring, to dilute sulphuric acid (not stronger than 1 pt. by weight of $S O^4 H^2$ to 5 pts. of water) till the acid is very nearly saturated. The precipitate is then left to settle, the liquid filtered, and the remainder of the acid removed by cautious addition of dilute baryta water. The moist peroxide of barium is very easily decomposed by sulphuric acid, but the action of the acid on the dried peroxide or even on the effloresced hydrate is very slow and imperfect.

Wurtz, Dictionnaire de Chimie, Pure et Appliquée. Paris, 1876. Vol. I, p. 1196.

Préparation.—La préparation de l'eau oxygénée parait au premier abord extrêment facile à réaliser. Il suffit de dissoudre du bioxide de baryum dans l'acide chlorhydrique, d'ajouter ensuite de l'acide sulfurique pour précipiter la baryte et remettre l'acide chlorhydrique en liberté. En recommençant un certain nombre de
169 fois la même opération, on obtient de l'eau de plus en plus chargée d'oxygéne et on se débarrasse à la fin du chlorure de baryum par du sulfate d'argent, qui donne du sulfate de baryte et du chlorure d'argent, de sorte qu'il reste de l'eau plus on moins riche en oxygène, $Ba O_2 + 2 H Cl. = Ba Cl_2 + H^2 O^2$.

Cette préparation, si facile en apparence, présente en réalité de sérieuses difficultés; c'est qu'il est presque impossible de se procurer du bioxyde de baryum pur. Celui du commerce renferme non seulement de la silice et de l'alumine qu'il a empruntées aux vases ou s'est faite la préparation de la baryte par la calcination de l'azotate de baryte, mais encore il contient de l'oxyde de fer et de l'oxyde de manganèse provenant de l'azotate de baryum pur; or ces oxydes décomposent par leur seule presénce l'eau oxygénée sans lui rein prendre, sans lui rein céder, de sorte qu'il suffit de traces de ces corps pour décomposer de grandes quantités d'eau oxygénée.

De sorte que, s'il est aisé de préparer une eau oxygénée très-peu chargée d'oxygène, il est extrêmement difficile d'obtenir une eau oxygénée très concentrée; c'est pourquoi nous décrivons ici la méthode employée par Thenard, avec tous les détails qu'il a donnés dans ses divers mémoires. Touts les précautions qu'il indique doivent être rigoureusement suivies, si l'on veut avoir un réuissite complète.

Translation of above extract from Wurtz, Vol. I, p. 1196.

Preparation.—The preparation of oxygenated water appears at first sight extremely easy. It suffices to dissolve binoxide of barium in hydrochloric acid, to add then sulphuric acid to precipitate the baryta and set at liberty the hydrochloric acid. By repeating the same operation a certain number of times there is obtained water more and more charged with oxygen, and at the end the chloride of barium is removed by sulphate of silver, which gives sulphate of baryta and chloride of silver, so that there remains water more or less rich in oxygen:

$$Ba\,O_2 + 2\,H\,Cl = Ba\,Cl_2 + H_2\,O_2.$$

This preparation, so easy in appearance, presents in reality serious difficulties, because it is almost impossible to procure pure binoxide of barium.

That of commerce contains not only silica and alumina, which it has derived from the vessels in which the baryta has been prepared by the calcination of nitrate of baryta, but it also contains oxide of iron and oxide of manganese, derived from the pure nitrate of barium. These oxides decompose, by their very presence, the oxygenated water without taking anything therefrom, without giving anything thereto, so that traces of these bodies suffice to decompose large quantities of oxygenated water.

Consequently, if it is easy to prepare oxygenated water very slightly charged with oxygen, it is extremely difficult to obtain exygenated water very concentrated. It is for this reason that we here describe the method used by Thénard, with all the details that he has given in his various memoirs. All the precautions which he indicates should be rigorously followed if it be desired to have a complete success.

Same, p. 1197.

On peut abréger la préparation de l'eau exygénée en se fondant sur ce que le chlorure de baryum est tres-peu soluble dans l'eau au-
171 dessous de 0°. On opére alors dans uns vase entouré d'un mélange de glace et de sel marin et l'on sépare de temps en temps le chlorure de baryum qui s'est déposé. Il faut dans ce cas ajouter dans la liqueur une petite quantité d'acide chlorhydrique concentré chaque fois que l'on veut y redissoudre du bioxide de baryum.

M. Pelouze' a proposé de remplacer l'acide chlorhydrique par l'acide fluorhydrique pour la preparation de l'eau oxygénée; l'avan-

filtrate contains can be precipitated by careful addition of dilute baryta solution. When the aqueous solution of the hydrogen dioxide thus prepared is brought over sulphuric acid *in vacuo* water evaporates and the solution of the dioxide becomes more concentrated. If during the concentration an evaporation of oxygen be noticed a drop or two of sulphuric acid should be added, as the dioxide is more stable in the presence of free acid than when perfectly pure. (Thénard.)

Same, p. 260.

When baryta water (barium monoxide) is mixed with hydrogen dioxide a precipitate of barium dioxide separates out; thus:

$$BaO + H_2O_2 = BaO(OH)_2.$$

175 Hydrogen dioxide also transforms many other basic oxides, especially in presence of an alkali, to peroxides. Thus manganeous salts become thus converted into manganese dioxide. On the other hand, these peroxides in presence of an acid are again reduced by hydrogen dioxide to basic oxide.

Same, p. 262.

An aqueous solution of hydrogen dioxide is an article of commerce, and is used for the purpose of cleaning and bleaching old and stained engravings and oil paintings. The dioxide has also been employed as an auricome for bleaching dark-colored hair.

Payen's Industrial Chemistry. Paul. London, 1878. Page 37.

Preparation.—The preparation of hydrogen peroxide is based upon the fact that certain metallic peroxides—as, for instance, potassium peroxide or barium peroxide—upon treatment with dilute acids yield oxygen, which is not separated in the free state, but combines with the water present, forming hydrogen peroxide. It is best to use barium peroxide for this purpose. This decomposes with diluted sulphuric acid according to the following equation:

$$Ba O_2 + \left.\begin{matrix} SO_2 \\ \hline H_2 \end{matrix}\right\} O_2 = \left.\begin{matrix} SO_2 \\ \hline Ba \end{matrix}\right\} O_2 + H_2O_2.$$

Hydrochloric acid is better suited for this purpose than sulphuric acid, because it forms a soluble salt of barium, which does not hinder the further action of the acid upon the peroxide, as
176 the barium sulphate does; but carbonic acid is most suitable for the preparation of pure hydrogen peroxide. In order to prepare it by the action of carbonic acid, an abundant stream of the washed gas is passed through distilled water in a beaker. To this water finely-powdered barium peroxide is added from time to time in very small quantities, so that there is never any great excess of

barium peroxide present in the liquid containing hydrogen peroxide, which in such case would be decomposed into water with the evolution of oxygen. After this operation has been carried on for some time the barium carbonate is filtered off and the solution evaporated *in vacuo* over sulphuric acid until the liquid assumes a syrupy consistence.

Hydrogen peroxide cannot be preserved long in this condition. In order to preserve it, it must be diluted in water and made slightly acid with hydrochloric acid. Even in this state it gradually decomposes, especially when exposed to light.

Uses.—Hydrogen peroxide has been used, according to the recommendation of its discoverer, Thénard, for restoring the white colors in pictures that had been turned gray or black. It acts in this case by giving off its oxygen, which oxidizes the black sulphide of lead and converts it into white sulphate of that metal. In this way the blackened colors of oil paintings have been restored by making use of water containing only two per cent. by measure of hydrogen peroxide. If hydrogen peroxide were cheaper it might be used with advantage for cloth-bleaching.

Hydrogen peroxide has been used in medicine, but at present only externally.

Nouveau Traité de Chimie Industrielle. By Wagner & Gautier. Deuzième edition, Français très augmentué.

177 PARIS, TILVAIN F. SAVOY, 1879,
77 BOULEVARD ST., GERMAIN.

Article. Blanchiment. Vol. II, p. 619.

Les agents employés par les blanchisseurs sont, outre l'air atmosphérique ozonisé; 4°. Le peroxyde d'hydrogène, bien que ce dernier corps ne puisse être considéré comme une substance dont l'application au blanchiment est encore dans l'avenir.

(Translation.)

The agents employed for bleaching are, besides ozonized atmospheric air, 4th. Peroxide of hydrogen; but this last named can only be considered a substance whose application to bleaching is still in the future.

Rudolf von Wagner's Jahres-Bericht uber die Leistungen der Chemischen Technologie. Vol. XXVI, for year 1880. Leipzig, 1881.

Page 349.

Wasserstoff superoxyd wird neuerdings vielfach zum Bleichen von Schmuckfedern, Seide und Haaren verwendet.

(Translation.)

Hydrogen peroxide has lately been applied to a considerable extent to the bleaching of feathers for ornament, silk, and hair.

Chemical Society Journal, published at London, 1881. New Series. Vol. 40, 1881. Abstracts, p. 474.

Hydrogen Peroxide. By A. H. Mason.

178 (Chemist and Druggist, 1881.)—The author gives a resumé of the literature relating to the preparation, properties, estimation, and application of peroxide of hydrogen. He thinks Thomsen's method of preparation the best available at present.

* * * * * * *

The therapeutical value of the peroxide seems to be small, judging by the quantity sold for medicinal purposes; but as a disinfectant it is largely used in dilute solution.

Hydrogen peroxide is, however, a valuable agent for bleaching hair, ivory, oil, wax, tobacco, and blood serum, and for cleaning old engravings and oil paintings. For these purposes its solution should be made strongly alkaline by addition of the strongest ammonia.

The use of the peroxide for the above purposes on the large scale is very much limited by its costly nature, and any cheap method of preparation would largely extend its sale.

F. C.

U. S. Circuit Court, Southern District of New York.

CHARLES MARCHAND *vs.* FREDERICK EMKEN.

The complainant, having offered in evidence certain extracts from books and periodicals published in English, French, and German, and translations of such as were in French and German, the same being marked "Complainant's Exhibit Extracts from Scientific Works, December 8, 1884, P. M., notary public," it is admitted that each one of the publications from which said extracts
179 & 180 were taken was published at the date indicated at the head of each extract, respectively, as the date of the respective publications from which such extracts were taken.

All objections made thereto are insisted upon and are not to be considered as hereby affected.

Dated February 17, 1885.

MARSHALL P. STAFFORD,
Defendant's Solicitor.
TURNER, LEE & McCLURE,
Complainant's Solicitors.

181 United States Circuit Court, Southern District of New York.
In Equity.

CHARLES MARCHAND *vs.* FREDERICK EMKEN.

Testimony taken, in surrebuttal, on the part of the defendant under and pursuant to the 67th rule of the Supreme Court of the United States, as amended, before John A. Shields, Esq., a standing examiner of said Court.

NEW YORK, *March 13th*, 1885.

Present: M. P. Stafford, Esq., of counsel for defendant, and Wm. H. L. Lee, Esq., of counsel for complainant.

FREDERICK EMKEN, the defendant, recalled in surrebuttal:

Counsel for complainant objects to the taking of any evidence whatsoever in surrebuttal on the ground that the defendant under the pleadings and proofs as they now stand has no right so to do.

Q. 1. The complainant, in answer to question 81 on rebuttal, has stated that in the manufacture of hydrogen peroxide the loss of material is from 10 to 30 per cent. when stirring is done by hand. What do you say as to the correctness of that statement?

A. I suppose that the loss of material has reference to the
182 yield of peroxide of hydrogen. When we are stirring by machine larger quantities of peroxide of hydrogen our yield is generally 12 per cent. below the theoretical yield. It is the same amount of deficiency of the theoretical yield, or an average in hand stirring, referring to the same large quantity of 120 gallons. This theoretical yield alluded to is determined by converting a small quantity of barium peroxide into hydrogen peroxide while the hand stirring is kept up and then determining the amount of hydrogen peroxide formed. The fact that this theoretical yield is larger is not due to hand stirring, but is due to the fact that I use for dissolving the barium an acid which does not form a precipitate with the same, and that I experience no loss in freeing or washing the precipitate in order to separate the hydrogen peroxide from it.

Q. 2. Is there any greater waste of material when the stirring is done by hand than when the stirring is done by machinery, the quantity of the mixture being the same in each case?

A. No.

Q. 3. In answer to question 80 in surrebuttal complainant says it is a practical impossibility to make 720 gallons of hydrogen peroxide in one kettle at the same operation and do the stirring by hand. What do you say as to the correctness of that answer?

Objected to on the ground that the witness has not shown himself to be competent to answer this question.

A. One man can with a stick easily impart the necessary motion to that quantity of liquid to make hydrogen peroxide, assuming that a proper method for making it is adopted. This proper method

has reference to the kinds of acid used, to the condition in which the barium is, and to the temperature of the liquid.

Q. 4. Assuming the same conditions in all respects, can any
183 quantity of hydrogen peroxide be made as well by hand stirring as by machine stirring?

The same objection.

A. Yes; it can just as well.

Q. 5. Is there any difficulty whatever in obtaining the same degree of concentration when the stirring is done by hand as when the stirring is done by mechanical appliance?

The same objection.

A. Not the slightest.

Q. 6. How large a quantity of hydrogen peroxide have you made at one operation by hand stirring?

A. One hundred and fifty gallons.

Q. 7. How recently have you done this?

A. Several times during the month of January last.

Q. 8. How came you to do the stirring by hand upon those occasions?

A. Our old factory burned down and the mechanical part in our new factory was not yet completed, so we were compelled to use men for stirring.

Q. 9. Did you make careful observations of the process and tests of the results on these occasions, when the stirring was done by hand?

A. Yes; I did.

Q. 10. State how those results and tests compared with those that take place when the stirring is done by mechanical appliance, in respect to time required, yield, waste, &c.

A. The average yield of a month's working with hand stirring was the same as our average yield when stirring by machine; also the time used was the same.

Q. 11. How many men did you employ in the process of making one hundred and fifty gallons when the stirring was done by hand?

184 A. Two men; one for attending to the operation and one for stirring.

Q. 12. Is one of these men also employed about the process when the stirring is done by machinery?

A. Yes, sir.

Q. 13. Then do you say that the only practical difference in any respect whatever between stirring by hand and stirring by machinery, as shown by your practical tests, is the saving of the time of one man during the process?

A. Yes; that is positively all.

Q. 14. Does the liquid or the mixture at any stage of the process of manufacturing hydrogen peroxide become so dense or of such great specific gravity as to make the stirring by hand difficult?

A. With our method of making peroxide of hydrogen the liquid

is as easy to stir as water itself, although a heavy precipitate is suspended therein. [If I should use hydrofluoric acid, as I believe complainant did at the time of taking out the patent, the liquid might not be as easy to be stirred, as the precipitate caused by this acid is apt to settle on the bottom.]

Objected to as irresponsive and as incompetent, and a motion to strike out the whole of the answer between the brackets will be made at or before the hearing of this cause.

Defendant consents that the portion of the last answer in brackets be stricken out.

Q. 15. About what is the density or specific gravity of hydrogen peroxide as manufactured for an article of merchandise?

A. It is only imperceptibly denser than water.

185 Q. 16. Is there any difference of difficulties arising from the presence of oxide of iron or oxide of manganese when stirring is done by machinery and when it is done by hand?

A. No; it would be absurd to claim it.

Q. 17. What do you say as to the presence or absence of those ingredients at all in the process?

A. With the proper method of making peroxide of hydrogen the presence of these oxides causes little, if any, difficulties.

Q. 18. State what, if anything, is done or may be done in the process to obviate the difficulties that might arise from this source.

A. A substance is added which forms an insoluble iron and manganese salt with these oxides. In this way the difficulty is obviated. This substance that I add is phosphoric acid.

Q. 19. In your process of manufacturing hydrogen peroxide is there any considerable quantity of barium in suspension in the liquid unacted upon by the acid at any time during the process?

A. No, sir.

Q. 20. What method do you employ to prevent such suspension?

A. Using such acids that form soluble salts of barium, and only having a small quantity of acid at a time in the mixture, and using a stirring apparatus that causes the liquid to present a broken surface; also using the barium in the hydrated form and upholding a medium temperature in the mixing vessel.

Q. 21. In what quantities at a time do you add the barium binoxide?

A. We add it in a continual stream.

Q. 22. In your process does the reaction take place practically on the instant of adding the barium so as to prevent its going into suspension in the mass of the liquid in any appreciable quantity?

A. Yes, sir.

186 Q. 23. Does the apparatus used by you impart a continuous movement of rotation of the liquid or in the liquid in vertical and horizontal planes or in either of such planes?

A. No, sir; the motion is that of a liquid moving in horizontal planes for a time and then thrown against an obstruction placed in a right angle to the current.

Q. 24. This answer refers to motion in the horizontal plane, does it?

A. Yes.

Q. 25. Then, instead of a continuous motion in a horizontal plane, as described in plaintiff's patent, your apparatus produces an interruption and cessation of motion in the horizontal plane, does it?

A. Yes; it does.

Q. 26. Does your apparatus produce any continuous motion whatever in a vertical plane—that is, a plane perpendicular or substantially so to the plane of the motion produced by the revolving blades?

A. No, sir.

Counsel for complainant, in order to avoid all question, makes seasonable objection to all of the foregoing questions and answers, and especially to such as treat of the defendant's method of making peroxide of hydrogen, and of the apparatus used by him, and of the motions imparted to the liquid thereby, because the same is not proper surrebuttal.

Adjourned by consent to Monday, March 16, 1885, at 2 p. m.

187 NEW YORK, *March 16th*, 1885—2 o'clock p. m.

Met pursuant to adjournment.

Present: Counsel as before.

The direct examination of Mr. EMKEN continued.

By Mr. STAFFORD:

Q. 27. Where text-books and treatises speak of the difficulty of manufacturing hydrogen peroxide as spoken of in Mr. Hedrick's testimony what degree of concentration is alluded to?

A. The peroxide of hydrogen undiluted with water, which is about thirty times stronger than the commercial, the preparation of the latter being very simple. By the word simple I mean easy.

Q. 28. Has there been any improvement in the making of hydrogen peroxide as alluded to in the text-books since it first became known?

This question and question 27 objected to because the witness has not shown himself qualified to answer the same.

A. There has been no material improvement made in the manufacture of peroxide of hydrogen from binoxide of barium since Thenard showed that dissolving binoxide of barium in acids furnished peroxide of hydrogen; neither is there any room for material improvement.

Q. 29. Has there been any improvement in the manufacture of binoxide of barium which has affected the manufacture or price of peroxide of hydrogen?

The same objections.

A. Yes; great improvements have been made in the manufacture

of peroxide of barium, as well in respect of the technical ap-
188 pliances as in the method itself. The price of this article is thereby also, on account of the larger use it is put to, been steadily decreasing. The price of peroxide of hydrogen has decreased in proportion on account of this.

Cross-examined by WM. H. L. LEE, Esq., *de bene esse:*

X Q. 30. When did you leave your former place of business, in 60th street?

A. On the 12th of December last.

X Q. 31. Where did you then move to?

A. To Long Island City, on Vernon avenue. It is about opposite 55th street, New York, on the water.

X Q. 32. Do you engage in any other business there beside the manufacture of hydrogen peroxide; and, if so, what?

A. Yes; we make hyposulphite of soda and chemicals generally.

X Q. 33. You speak of having made 150 gallons of peroxide of hydrogen at a single operation, doing the stirring by hand. When did you first do this?

A. After the fire occurred in our old factory; after the 12th of December last—till the middle of January.

X Q. 34. You misunderstand my question. I wish you would specify the date, as nearly as you can, upon which you first did this.

A. About the 15th of December last.

X Q. 35. What was the size of the vessel that you used?

A. The size of the wooden tub was three and one-half feet in diameter and about three feet high.

X Q. 36. What was its capacity?

A. About 200 or 225 gallons.

X Q. 37. What was the size and shape of the implement which you used to do the stirring?

A. The piece of board about four feet long and two or three inches wide.

189 X Q. 38. Was its width uniform of its entire length?

A. It was rounded off at the end at which it is handled.

X Q. 39. Were you personally present during the whole of the operation and did you personally superintend the same? Remember that I am referring to the first time that you made 150 gallons of peroxide of hydrogen at one operation by hand stirring, which you say was about December 15th.

A. Yes, sir; I was present and superintended the making of this lot.

X Q. 40. Who else was present?

A. William Hahn and Hans Focke; that is all. No one else during the whole length of the time.

X Q. 41. At what hour of the day was the operation begun and when did it end?

A. As near as I can remember it began at one o'clock in the afternoon and ended four hours later.

X Q. 42. Did one man do the stirring during all this time?

A. One man did the stirring at a time. He was relieved by the other one.

X Q. 43. Why did your men relieve each other in doing the stirring?

A. Because the continual working tired them out.

X Q. 44. Who measured the amount of acid that was used on this occasion?

A. Nobody did.

X Q. 45. Who measured the amount of binoxide of barium that was used on this occasion?

A. John Brane weighed the barium in my presence.

X Q. 46. How many pounds of barium did you use?

A. About two hundred pounds.

X Q. 47. Were there any other ingredients used on this occasion besides the two hundred pounds of barium and the acid and water?

190 A. Instead of water I used a diluted or a weak solution of peroxide of hydrogen.

X Q. 48. Who made this diluted or weak solution of peroxide of hydrogen, and of what strength was it?

A. We made it. The strength was one and two-tenths per cent., as far as I can remember.

X Q. 49. When was this weak solution made and how had it been made, as far as the stirring is concerned?

A. The weak solution was the wash water from the preceding operation, which was also made while we done the stirring by hand.

X Q. 50. How many gallons of this weak solution did you use on this occasion—150?

A. About 100 gallons, as far as I can remember.

X Q. 51. Do you mean to say that this 100 gallons of weak solution of peroxide of hydrogen and the 200 pounds of barium made 150 gallons of peroxide of hydrogen?

A. Yes, sir.

X Q. 52. How did you come to have on hand 100 gallons of weak solution of peroxide of hydrogen when you performed this first operation, about December 15th last?

A. As I stated, we obtained it in washing the precipitate of the preceding batch.

X Q. 53. How much peroxide of hydrogen had you made at the preceding batch?

A. I believe about 100 gallons.

X Q. 54. Do you remember its strength?

A. Three and one-tenth per cent.

X Q. 55. State exactly what you did in obtaining this 100 gallons of washings from the preceding batch.

A. The precipitate was mixed with a sufficient quantity of water and the liquid then again separated from the precipitate. This precipitate had accumulated for several days.

191 X Q. 56. You say that this precipitate was mixed with a sufficient quantity of water. How was it mixed and what amount of stirring was done?

A. The mixing up was done in open vats, with sticks in the hands of one or two men; I do not remember which.

X Q. 57. Was none of the stirring done by machinery?

A. No, sir.

X Q. 58. How long did it take to do this mixing in open vats, with sticks in the hands of one or two men?

A. About ten minutes.

X Q. 59. Do you mean about ten minutes for each vat?

A. Yes, sir.

X Q. 60. What was the size of these vats?

A. About four feet diameter, two and one-half feet high.

X Q. 61. How much of the precipitate was in the bottom of each vat on the occasion referred to?

A. About 350 pounds in each.

X Q. 62. And how many vats were there?

A. There were two of them.

X Q. 63. Then, having obtained this mixture, this weak solution of peroxide of hydrogen, by the process you have just described, what was done with it?

A. It was filled into the mixing tank after weighing it off in pails.

X Q. 64. How many men were engaged in this operation of weighing it off in pails?

A. I suppose two or three.

X Q. 65. How long did it take them to transfer the 100 gallons of this weak solution after weighing it off in pails?

A. About five minutes; maybe ten.

X Q. 66. What is the size of the pails you used?

A. Three gallons.

X Q. 67. By what means was this weak solution discharged from the open vats?

A. By syphoning off.

192 X Q. 68. What was the smallest diameter of syphon tube?

A. One inch is the diameter of the opening.

X Q. 69. Is not the diameter of the tube in some of its parts smaller than this? I refer to the internal diameter.

A. No, sir.

X Q. 70. Do you mean to say that with a syphon of this size and with pails of only three gallons you can transfer 150 gallons in five or ten minutes?

A. I believe it might.

X Q. 71. Did you ever time this?

A. No, sir.

X Q. 72. Now, referring to this first occasion upon which you made 150 gallons of peroxide of hydrogen by hand stirring, about December 15th last, please state the strength of the peroxide of hydrogen that you made on this occasion.

A. Three one-tenth per cent. was the strength.

X Q. 73. How do you know this?

A. Because I tested it.

X Q. 74. To whom was it sold?

A. I do not remember.

X Q. 75. Besides yourself and Mr. Marchand, the complainant, do you know of any one else who manufactures peroxide of hydrogen as a commercial article in this country?

A. Yes.

X Q. 76. Who?

A. John Bene and Mr. Jonas, a firm of druggists in the Bowery; Simon & Cappel. That is all I know of.

X Q. 77. How long after you first made the 150 gallons of peroxide of hydrogen by hand stirring was it before you again made as large a quantity as this at one operation, doing the stirring by hand?

A. I think it was the third day after.

X Q. 78. When was the next time when you did the same thing?

A. I think we again had an interval of two days in which we did not make.

193 X Q. 79. When was the next time when you did the same thing?

A. The second or third day after.

X Q. 80. And did you continue to make one hundred and fifty gallons at a single operation, doing the stirring by hand until about the month of January? If not, state what, in fact, you did do, bearing in mind that I wish only to know about those occasions upon which you made in the vicinity of one hundred and fifty gallons or upwards at a single operation, doing the stirring by hand.

A. We have not made one hundred and fifty gallons each time—only once in about three times we made this quantity—but have always done the stirring by hand during this period.

X Q. 81. And when you made as large a quantity as this was your experience substantially the same as you have already described in connection with the first batch of one hundred and fifty gallons?

A. Yes; it was about the same.

X Q. 82. The machinery which you now use for doing your stirring is very simple in its character, is it not?

A. Yes, sir.

X Q. 83. Then why did you delay a month in putting it in working condition?

A. Because boilers and engine were not in working order before that time.

X Q. 84. And as soon as they were in working order you stopped doing your stirring by hand and begun doing it by machinery, did you not?

A. Yes, sir.

X Q. 85. What is the shape of the two-hundred-gallon tub that you have already referred to?

A. It is an ordinary open tub, cylindrically shaped, somewhat larger at the top than at the bottom.

X Q. 86. Is it rounded at the bottom?

A. No; it is flat at the bottom.

194 X Q. 87. When you did the stirring by hand, in making such large quantities as one hundred gallons or upwards did

you have in the interior of the vessel any projecting board or boards such as you previously had used?

A. No, sir.

X Q. 88. What is the largest size vessel that you have at the present time?

A. Twenty-two hundred gallons.

X Q. 89. How much peroxide of hydrogen have you ever made at a single operation?

A. About 150 gallons.

X Q. 90. How long have you had your 2,200-gallon vessel?

A. One of them we had since a couple of years.

X Q. 91. Have you ever used it for making peroxide of hydrogen?

A. No, sir.

X Q. 92. What is the largest vessel that you now have which you use for this purpose?

A. The vessel I mentioned of three and one-half feet diameter and three to three and one-half feet height.

X Q. 93. When you speak of the theoretical yield of peroxide of hydrogen, does not this refer to the yield that there would be by the conversion of a given quantity of peroxide of barium into hydrogen peroxide if there was absolutely no loss of oxygen?

A. Yes, sir.

X Q. 94. You say that there is no greater loss or waste of material when the stirring is done by hand than when it is done by machinery. Now, if you have ever made any experiments in making large quantities of hydrogen peroxide and have kept the exact and accurate data and results of such an experiment please state the same fully and at large.

A. I made to-day peroxide of hydrogen from half a gramme of peroxide of barium while the dissolving was aided by hand
195 stirring. We made at the same time peroxide of hydrogen from 150 pounds of the same peroxide of barium while the stirring was done by machinery. The first test showed the barium to contain 84 per cent. of peroxide of barium. The test applied to the peroxide of hydrogen formed showed it to contain 3 per cent. in addition to the one per cent. that was in the wash-water used. If we had had the same good result with the large quantity as we had with the small, our yield should have been about 15 per cent. higher in the larger quantity.

X Q. 95. How much did you make to-day by the machine stirring?

A. Seventy-five gallons.

X Q. 96. And how much did you make by hand?

A. About two grammes.

X Q. 97. How does a gramme compare with a pint?

A. A pint of water will weigh about 450 grammes.

X Q. 98. Is there any other experiment of a like nature that you have made of which you can give the exact, accurate data and results?

A. I can give the exact data and results of six operations of mak-

ing 125 gallons of peroxide of hydrogen at a time, three of which are made by hand stirring and three by machine stirring.

X Q. 99. Why did you not give them on your direct examination?

A. I testified to the effect that I made these experiments, and testified as to their result. The data I did not have with me at the time.

X Q. 100. Will you please point out where you so testified?

A. In the answers to questions 7 and 13.

X Q. 101. I do not consider that your answers to those questions will bear the construction you put upon them. I now call your attention again to cross-questions 98, 99, and 100, and ask you whether you wish to correct or add to your answer to question 100.

196 A. No; I have nothing to add.

X Q. 102. Have you the data here present with you?

A. No; I did not take them along, but can produce them at any time.

X Q. 103. In what shape are they at the present time?

A. They are notes made on paper, which are at present in a desk in my house.

Counsel for complainant now gives notice that as it appears that the evidence contained in the answers to questions 7 to 13, inclusive, are not the best evidence of the facts sought to be proved, so far as the same relates to the experiments therein referred to, he will move to strike out said questions and the answers thereto on the ground that they are not the best evidence of the facts therein sought to be proved, and on the further ground that they are indefinite.

Adjourned to Tuesday, March 17, 1885, at 2 p. m.

NEW YORK, *March 17th*, 1885—2 o'clock p. m.

Met pursuant to adjournment.

Present: Counsel as before.

Adjourned to Saturday, March 21st, 1885, at 11 a. m.

197 NEW YORK, *March 21st*, 1885—11 o'clock a. m.

Met pursuant to adjournment.

Present: Counsel as before.

The cross-examination of Mr. EMKEN continued by WM. H. L. LEE, Esq.:

X Q. 104. You say, in answer to Q. 21, that you add the barium peroxide in a continual stream. How do you do this?

A. The hydrated barium peroxide is contained in a vessel standing above the mixing tank. In there it is mixed with about twice its amount of water. This semi-liquid substance runs through a faucet into the mixing tank.

X Q. 105. What is the shape and size of the faucet?

A. It is an ordinary wooden faucet about ten inches long, having a quarter-inch opening.

X Q. 106. What is the shape of the faucet?

A. It consists of two pieces of wood, both hollow, the smaller one inserted into the larger one at a right angle.

X Q. 107. Describe the position of these two pieces of wood with reference to the vessel of which it forms the outlet?

A. The faucet is inserted at the side of the vessel and on the bottom of the same.

X Q. 108. Does one of the hollow pieces of wood that you have just spoken of fit into the vessel so as to be horizontal when in position?

A. Yes, sir.

X Q. 109. How large is the piece of wood?

A. About an inch in diameter, ten inches long.

X Q. 110. And the aperture you say is about a quarter of an inch in diameter?

A. The aperture of the small piece through which the liquid runs finally is a quarter of an inch.

198 X Q. 111. What is the aperture of the horizontal piece?

A. About half an inch.

X Q. 112. What is the size of the smaller piece?

A. About half an inch in diameter, or a little larger, and about four inches long.

X Q. 113. You say that the barium peroxide is mixed with twice its amount of water. Do you mean that before it is so mixed it is hydrated, or that it becomes hydrated by the mixture?

A. The water that has been used for hydrating is partly left mixed with the barium.

X Q. 114. What I wish to know is this: In your answer to question 104 you speak of hydrated barium being mixed with about twice its amount of water. Now, do you mean that the barium, after it has been hydrated, is mixed with twice its amount of water in addition to the water that has already been applied to it to hydrate it?

A. No, sir.

X Q. 115. What do you mean?

A. I mean that the hydrated barium is in presence of about twice its amount of water. As to the source of the water, I have explained it in my answer to question 113.

X Q. 116. The hydrated barium that you use is a mixture of barium and water, is it not?

A. Yes, sir; it is a mixture of hydrated barium peroxide and water.

X Q. 117. Question repeated.

A. Yes.

X Q. 118. Now, you say that what you use is a mixture of binoxide of barium, mixed with about twice its amount of water. Now, what I wish to know is this: Is what you use a mixture of dry binoxide of barium with twice its amount of water, or is it a mixture of hydrated binoxide of barium with twice its amount of water?

A. It is a mixture of the latter.

199 X Q. 119. That is, in addition to the water which is already in the hydrated barium, there is added to form the mixture about double the quantity of water?

A. No, sir; there is no water added. What I mean is that besides the water which is in chemical combination with the binoxide to form a hydrate thereof there is water present to the amount about of twice the quantity of hydrated barium. This water is left in it since the hydrating process.

X Q. 120. What is the chemical formula of hydrated binoxide of barium?

A. Ba O_2 2 (h_2 O).

X Q. 121. In the formula that you have just given is the binoxide of barium thoroughly hydrated—that is, has it united chemically with as much water as it can combine with?

A. This formula represents the hydrate according to the atomic values of barium binoxide and water. There may be so-called nonsaturated hydrates which contain more water, but this I do not know. The formula in question represents the hydrate in thorough chemical combination.

X Q 122. Then is hydrated binoxide of barium a well-known chemical combination, represented by the formula you have already given?

A Yes, sir.

X Q. 123. How many pounds of water will combine, say with one hundred pounds of anhydrous binoxide of barium, to thoroughly hydrate it and make the whole mass hydrated binoxide of barium?

A. According to this formula, about nineteen pounds.

X Q. 124. Now, when your hydrated binoxide of barium is mixed with water, as you have already stated, it becomes a soft mixture of about the consistency of tar or rather thick cream, does it not?

A. Yes, sir.

X Q. 125. What is the size of the vessel which holds this
200 mixture of hydrated binoxide of barium and water which you use in making peroxide of hydrogen?

A. About two feet diameter and about fifteen inches high.

X Q. 126. Do you mean to say that a mixture of this nature and of this consistency will flow through a hollow stick ten inches long, with an aperture half an inch in diameter, in a horizontal direction, and then flow through a vertical hollow stick having an aperture a quarter of an inch in diameter, from a vessel fifteen inches high and two feet in diameter, in a steady stream?

A. Yes; that is what it does and what I mean to say.

X Q. 127. Has any one seen this beside yourself and those in your employ?

A. Yes; we have frequently outsiders in that part of our factory where this is done. These have had an opportunity of seeing it.

X Q. 128. Mention one such outsider.

A. Our iceman.

X Q. 129. Give the name of one person, outside of yourself and those in your employ, who has seen this steady flow under the conditions mentioned in X Q. 126 who would be apt to notice such a thing or to take an interest in it.

A. The son of one of our employees, Hans Brane; Machinist

Thomas Kerr, my wife, and my mother. That is all I can think of at present.

X Q. 130. What is the age of Hans Brane?

A. About twenty-eight years.

X Q. 131. Where does he reside?

A. He lives near our factory in Ravenswood, on Vernon avenue.

X Q. 132. Have you or your brother or any firm with which either of you have been connected ever employed him in any way?

A. Yes; we employed him some years ago for a week or two.

X Q. 133. What is his present occupation?

201 A. He works in a shoe factory down-town in New York.

X Q. 134. How long has he been connected with the shoe business?

A. Since ten or twelve years, I suppose.

X Q. 135. Where does Thomas Kerr reside?

A. His machine shop is on the corner of Fifty-fifth street and First avenue. I do not know where he resides.

X Q. 136. You say he is a machinist; specify more definitely his occupation.

A. He repairs engines and other machinery, puts up shafting and pulleys, and does steam-fitting.

X Q. 137. How often has he had an opportunity to observe this flow of the mixture about which I have asked you in Q. 126, and under what circumstances?

A. About half a dozen times; whenever he wanted to see me in reference to work to be done in his line.

X Q. 138. So each one of the half dozen times that he called upon you you were always in the midst of making peroxide of hydrogen. Are you quite positive as to this?

A. I am positive that he had at least six times the opportunity of seeing the thing in question.

X Q. 139. You say, in answer to Q. 137, that he had this opportunity whenever he wanted to see you in reference to work to be done in his line. How does it come to impress itself on your memory that every time he so wanted to see you you happened to be making peroxide of hydrogen; have you any definite and distinct recollection on the subject?

A. I did not want to say that every time when he called to see me he saw the peroxide making, but I am sure that every time when he saw the peroxide being made his call was in reference to work in his line.

202 X Q. 140. How does it happen that your memory is so definite in regard to the fact that you were making peroxide of hydrogen on several occasions when he did call?

A. Because we were making peroxide of hydrogen from 7 o'clock in the morning till 3 in the afternoon for a long while, and that we needed Kerr's services during this time. I have mostly seen him around noon time.

X Q. 141. You say you were needing Kerr's services. In what capacity and in what connection?

A. For hanging shafting and repairing engine.

X Q. 142. For how long a time did you continue making peroxide of hydrogen every day from 7 till 3, and where and when was this?

A. We have done it two years ago. I believe in February and March; also last year from January to June.

X Q. 143. Did you frequently have occasion to employ Thomas Kerr?

A. Perhaps once a month on the average.

X Q. 144. How long have you used this vessel holding the mixture of hydrated binoxide of barium and water and the device for discharging the same which you have already described?

A. A little over two years from the date that we began to make peroxide of hydrogen.

X Q. 145. How often did you clean out the vessel and discharge tubes?

A. It is cleaned every morning before putting the stuff in by running warm water through it; also every evening after using it.

X Q. 146. During your experience in using these devices have you never had the discharge pipe stopped up or flowing irregularly?

A. Yes; we had in the beginning, by allowing the substance to become very cold.

X Q. 147. Well, what did you do then, and when did you remedy the evil?

A. We cleaned the tubes out and kept the liquid warmer. We have done this shortly after, in January, 1883.

203 X Q. 148. Well, since that time have you never had the discharge pipe stopped up?

A. No, sir.

X Q. 149. Nor the passage of the mixture flowing irregularly?

A. No; the flow of the mixture is very regular, and is regulated by the workingmen, if the stream is wanted to be smaller or greater.

X Q. 150. Now, referring to your answer to question 27, do you mean to include among the text-books and treatises referred to in the question the various extracts from scientific works composing Complainant's Exhibit Extracts from Scientific Works?

A. Yes; I do.

X Q. 151. Do you mean to say that in all the extracts in the exhibit referred to, where the method of making peroxide of hydrogen is described, that the description refers to peroxide of hydrogen undiluted with water?

A. No; I mean to say whenever they speak of the difficulty of making peroxide of hydrogen they have reference to peroxide of hydrogen undiluted with water.

X Q. 152. Are you as sure of your answer to the last question as you are of anything that you have stated in your deposition?

A. Yes; I am.

X Q. 153. Between the last question and the answer you examined a printed copy of the extracts referred to, did you not?

A. Yes; I did.

X Q. 154. Now, in the Complainant's Exhibit Extracts from Scientific Works several of the extracts describe how peroxide of

hydrogen may be made pure or rather with a comparatively small mixture of water. In all such descriptions, however, is not pure peroxide of hydrogen described as made in this way: First, there is made a mixture of peroxide of hydrogen and water, and
204 then the water or nearly all of it is separated from the peroxide of hydrogen?

A. Yes, sir.

X Q. 155. And is not this mixture which is first made before the separation of the water, as referred to in the latter part of the last question, of about the strength of the aqueous solution of peroxide of hydrogen, which is the commercial article known as peroxide of hydrogen?

A. No; not as far as the extracts from Fowne's Chemistry and Watts' Dictionary of Chemistry (Vol. 3, page 196) are concerned. The latter extract refers to a solution about twice as strong as the commercial.

X Q. 156. Then, as to the extracts other than those two, your answer is yes?

A. Yes.

X Q. 157. Now, you say that the extracts from Watts' Dictionary of Chemistry (Vol. 3, page 196) refer to a solution about twice as strong as the commercial; of how many volumes capacity is the solution referred to in this extract?

A. From 25 to 30.

X Q. 158. Now, as to the extract from Fowne's Chemistry, of what strength is the solution there referred to?

A. The strength of the solution is not given in figures, but the mode of preparation implies that it will have not less than twice the strength of the commercial.

X Q. 159. That is, it will have from 25 to 30 volumes capacity?

A. About that.

X Q. 160. Is there any method known of separating the water or nearly the whole of the water from the peroxide of hydrogen except by placing the vessel containing the mixture in a dish containing oil of vitriol and placing the same under the receiver of an air-pump, thereby forcing the water to evaporate?

205 A. Yes; there is. Any substance eager to absorb water will replace oil of vitriol; also the use of an air-pump is, in my experience, more detrimental than serviceable; currents of dry, warm air are very efficient for freeing the mixture of most of its water.

X Q. 161. How nearly pure have you ever obtained peroxide of hydrogen by means of currents of dry, warm air?

A. I have obtained it of a strength of 25 per cent., equaling about 80-volume capacity.

X Q. 162. Referring to the extracts from Fowne's Chemistry and Watts' Dictionary of Chemistry (Vol. 3, page 196), the methods there described can be used to produce a solution much weaker than 25 or 30 volume capacity, can it not, if that should be deemed desirable?

A. Yes; it can.

Redirect by Mr. STAFFORD:

R. D. Q. 163. The process of manufacture—that is, the principles underlying the manufacture—are substantially the same, are they not, whether the strength of the product is high or low?

A. Yes; they are.

R. D. Q. 164. Wherein lies the greater difficulty of making hydrogen peroxide of high concentration or strength over making it of the low or commercial strength?

A. It lies in the keeping and evaporating of solutions of hydrogen peroxide when their strength exceeds that of the commercial product by about five times.

R. D. Q. 165. Why is it more difficult to obtain a high degree of concentration?

A. Because peroxide of hydrogen of a high degree of concentration is relatively much more unstable than the weaker solutions, and consequently the strong solutions will decompose in the course of concentration by evaporation.

206 R. D. Q. 166. Do you mean that the evaporation which it is necessary to perform in the process of manufacture is more likely to cause decomposition when there is a high concentration than when there is a low one?

A. Yes; that is what I mean.

R. D. Q. 167. And is it in this that the greater difficulty of manufacturing the hydrogen peroxide of a high degree of concentration consists?

A. Yes; in this only.

R. D. Q. 168. Where you have spoken in your testimony of the "commercial strength" of hydrogen peroxide what degree of concentration have you referred to or meant?

Objected to as already answered.

A. I have referred to solutions containing three and one-half per cent. of hydrogen peroxide or of twelve volumes capacity; this is the strength at which we sell it.

R. D. Q. 169. The hydrated barium as introduced by you is not at the time of introduction of the thickness or consistence indicated by the formula given by you on cross-examination, is it?

A. Hydrated peroxide of barium as indicated by the formula is a dry substance; this is in suspension in about twice its amount of water when used in the way as described.

R. D. Q. 170. Do you do anything to aid the flow of this mixture of barium during the process of manufacturing?

A. Yes; there is a stirrer revolving in this vessel to aid suspension.

Recross by W. H. L. LEE, Esq.:

R. X Q. 171. You have stated that when you spoke of the commercial strength of hydrogen of peroxide you referred to solutions containing three and one-half per cent. of hydrogen perox-
207 ide. Do you mean three and one-half per cent. by weight or three and one-half per cent. by bulk?

A. In designating the percentage there is in chemistry never anything else referred to but the weight, unless the volume is specially mentioned.

Answer objected to as irresponsive and as one which the witness has not shown himself qualified to make, and a motion will be made to strike out the same at or before the hearing.

R. X Q. 172. Question repeated.

A. By weight.

R. X Q. 173. In chemically pure hydrogen peroxide of what volume capacity is the substance?

A. About 350.

R. X Q. 174. When the hydrated binoxide of barium is thrown into the acid solution is not the barium separated from the water by the contact of the acid?

A. No; not before the acid dissolves it.

R. X Q. 175. But it is separated from the water, is it not?

A. No; it is not.

R. X Q. 176. It contains hydrated binoxide of barium during the whole process of manufacturing peroxide of hydrogen?

A. No; it dissolves and forms peroxide of hydrogen.

R. X Q. 177. When it dissolves and forms peroxide of hydrogen is it not separated from the water with which it had previously been in chemical union?

A. It does not exist any more when it dissolves. I cannot speak of separation of binoxide of barium any more.

Re-redirect by Mr. STAFFORD:

R. R. D. Q. 178. When the chemical reaction takes place between the barium and the acid in the process of manufacturing hydrogen peroxide what becomes of the water with which the barium was in combination prior to the reaction?

208

A. It is set free.

FREDERICK EMKEN.

Adjourned to Thursday, March 26, 1885, at 2 p. m.

NEW YORK, *March 26th*, 1885—2 o'clock p. m.

Met pursuant to adjournment.

Present: Counsel as before.

Dr. L. H. FRIEDBURG, a witness produced on the part of the defendant, being duly sworn, deposes and says:

Q. 1. Please state your name, age, residence, and occupation.

A. L. H. Friedburg; age 38 years; I reside at 40 East 10th street, New York city; I am a chemist.

Q. 2. What is your business?

A. I am a chemist.

Q. 3. How long have you been a chemist?

A. For the last fifteen years.

Q. 4. Where were you educated in chemistry?

A. At the Universities of Goettingen and Heidelberg, Germany.

Q. 5. Did you graduate from either of these universities?

A. From the University of Goettingen, and received the degree of Ph. D.

Q. 6. Did you take a special course in chemistry?

A. Yes, sir.

Q. 7. When did you receive the degree?

209 A. In spring of 1870.

Q. 8. State what you have done since that time in the way of chemical work, employment, or business.

A. Well, I first was assistant of Professor Bunsen in his chemical laboratory, in Heidelberg for a year. Later on I was assistant of Professor Wöehler, of Goettingen, in his chemical laboratory. At the same university I was installed as privat dockute. Further, I was assistant in Bonn and Berlin, in chemistry; then I turned towards technical chemistry, which was about in 1874, and helped putting up and conducting chemical works of different kinds and in different countries, and have been doing that since that time until now, mainly; also working in chemical factories as a chemist.

Q. 9. Have you made any test or experiment in the manufacture of hydrogen peroxide to ascertain whether there is any practical difference or advantage in doing the stirring by machinery instead of by hand?

A. I did.

Q. 10. From such test can you state whether stirring by machinery or mechanical appliances has any advantage whatever in the results over stirring by hand except in the saving of labor of men to do the stirring?

Objected to, as the witness has not shown himself as qualified to answer the question.

A. I can.

Q. 11. Please state what the fact is in that regard.

A. The fact is, according to my experiment, that there is materially no difference in the result obtained in either doing the stirring by machinery or by hand.

210 Q. 12. Then do you say that the only practical advantage of machine stirring instead of hand stirring in the process of manufacturing hydrogen peroxide is in the saving of the labor of men employed to do the hand stirring?

The same objection, and objected to as leading.

A. I do say yes.

Q. 13. What is the purpose of stirring the mixture at all in making hydrogen peroxide?

The same objection.

A. To produce a uniform reaction between the substances which are to act upon each other.

Q. 14. Has it any purpose whatever other than to bring the particles of barium in contact with the acid?

A. None other, according to my statement in the last answer.

Q. 15. Has one kind of motion or motion in one direction or any combination of motions any advantage over another, provided the two bring the particles of barium and acid in contact with equal rapidity and regularity?

A. It has not.

Q. 16. Is the screw a well-known and familiar means of stirring in all manufactures of chemicals where an agitation of the different elements or ingredients is requisite or desirable?

A. It is.

Q. 17. State some of the instances in which a screw has long been used for such a purpose.

A. For instance, in the manufacture of tartaric acid. The screw is used in that process every time when a precipitation of sulphuric acid by means of milk of lime (which, too, precipitates gypsum) is required. It is used for precipitating cream of tartar from a solution of tartaric acid, by adding to which a solution of caustic potash in necessary quantities.

211 Q. 18. How long have you known the screw to be used in the particular instances you have mentioned?

Objected to as incompetent under the pleadings.

A. For the last five years.

Q. 19. Please state how the barium was introduced and the appliance used for that purpose in the experiments made by you in the manufacture of hydrogen peroxide?

A. The barium peroxide was contained in the state of an emulsion in water, commonly called milk, in a cylindrical vessel broader than a common pail. The vessel had a faucet, similar to a wooden faucet on a keg of wine or beer, at its lower end, towards the side where it should run into the mixture kettle. A stirrer kept moving this milk continuously during the entire operation of the process.

Q. 20. Did the barium flow through this faucet with ease and regularity or did it clog up?

A. It flowed through with ease and regularity, only at the beginning of the operation a clearing of the faucet by a metal wire was necessary.

Cross-examined by Mr. W. H. L. LEE:

X Q. 21. How long have you known the defendant?

A. Since the day before yesterday.

X Q. 22. How long have you known of peroxide of hydrogen?

A. Ever since I began to study chemistry.

X Q. 23. It has powerful bleaching qualities, has it not?

A. It has.

X Q. 24. How long have you known that this substance had powerful bleaching qualities?

A. For the last ten years, more or less.

212 X Q. 25. For these ten years past it has been commonly

known among scientific men that it had such bleaching qualities, has it not?

A. Yes, sir; and longer.

X Q. 26. You speak in your direct examination of certain tests that you have made, by which you compared the manufacture of hydrogen peroxide when the stirring was done by hand and when it was done by machinery; how many such tests have you made?

A. I have made two comparative tests in this regard—one of each.

X Q. 27. What was the strength of the solution that you obtained on each occasion?

A. The strength was the same, it being every time about four and two-tenths per cent. of peroxide of hydrogen.

X Q. 28. Four two-tenths per cent. by weight or by bulk?

A. Four two-tenths per cent. by weight, of course.

X Q. 29. About how many volumes capacity would that be?

A. Well, it corresponds to about thirteen.

X Q. 30. How long did it take to perform the operation by hand stirring?

A. The entire operation lasted for about two hours and a half.

X Q. 31. Were you present during the entire operation?

A. I was.

X Q. 32. How did you ascertain the strength?

A. By the permanganate test.

X Q. 33. Describe what you did.

A. I took two cubic centimetres of the liquid to be tested and diluted them with sufficient acidulated water; then from the permanganate burette I made the permanganate solution run into the liquid to be tested until faint lasting rose color appeared.

X Q. 34. Did you take the liquid that you tested yourself from the mass?

213 A. It was taken underneath my eyes.

X Q. 35. Where and when was this test made?

A. It was made the day before yesterday, at Mr. Emken's factory in Ravenswood, Long Island.

X Q. 36. Did you test the water before any of the binoxide of barium was mingled with it?

A. I tested it and found it to be acid.

X Q. 37. Did you test it to ascertain whether it contained any percentage of peroxide of hydrogen?

A. I did not; but I know that it did contain peroxide of hydrogen.

X Q. 38. How did you know that it did?

A. Being informed that it was the wash-water of the previous day's filtered press.

X Q. 39. Prior to that time had you ever seen peroxide of hydrogen made?

A. I did, and made it myself.

X Q. 40. How large a quantity had you ever made prior to that time at one single operation?

A. I cannot tell, because the cases referred to were merely chemi-

cal laboratory investigations and not what is called chemical manufacture.

X Q. 41. Had you ever made as much as a gallon at one operation?

A. I think I have, because I made it more concentrate.

X Q. 42. Had you ever made as much as five gallons at a single operation?

A. I do not think I have.

X Q. 43. Its powerful bleaching properties being well understood for so many years, was not the reason of its comparatively small use in the arts as a bleaching agent for many years after its properties were known due to the expense of manufacturing it?

A. I think that is not the reason.

X Q. 44. What is the reason?

A. The reason is mainly that, until about twelve years ago, to my knowledge, it was not generally known that peroxide of
214 hydrogen could be kept in a watery acidulated solution for any considerable length of time without decomposing.

X Q. 45. Well, since the fact that it could be kept has been known why was it that for a number of years thereafter it was not extensively used as a bleaching agent in the arts?

A. It was used ever since this was known for such purposes. It was made largely in London.

X Q. 46. Are you not aware that the price of peroxide of hydrogen as a commercial article in this country was, as late as 1879, from eight to ten dollars a gallon, and that it was used almost exclusively for bleaching hair down to that date?

A. I cannot say that I know for sure either one or the other.

X Q. 47. According to your best information, are not the facts as stated in the last question true?

A. As regards the price, I do not know, and as regards the uses, I know it was used for bleaching fatty oils ever since the time it was offered to the public.

X Q. 48. To what extent was it used for bleaching fatty oils?

A. That is hard to say, since some of the refiners of fatty oils generated *with* peroxide of hydrogen for themselves in their refining tubs.

X Q. 49. Apart from such use of peroxide of hydrogen by refiners who generated it for themselves, was its use extensive for bleaching fatty oils?

A. I am not aware of it. I do not know.

X Q. 50. Are you not aware that at the present time peroxide of hydrogen as a commercial article is sold in this country at from one dollar and fifty cents to two dollars a gallon?

A. I do not know the price, but since you say so I believe that it is correct.

X Q. 51. Are you not aware that at the present time it is exclusively used in this country for bleaching feathers and many other articles?

215 A. Hair, feathers, and fatty oils are, to my knowledge, the substances which are bleached mainly by peroxide of hydrogen.

X Q. 52. Are not Tussak silk, bones, and ivory also bleached by this substance at the present time quite extensively?

A. Possibly, but not to my positive knowledge.

X Q. 53. Now, referring to the test which you described a short time ago, will you please state the concentration of the permanganate of potash solution that you used for making the test?

A. It was one-tenths ($\frac{1}{10}$8) normal solution—a normal solution of any pure chemical compound—meaning an amount responding to its atomic weight dissolved in one thousand cubic centimetres of pure distilled water, while one-tenths normal solution is a solution of one-tenth that strength.

X Q. 54. In explanation of your last answer, please state what quantity in weight of permanganate of potash should be dissolved in a thousand cubic centimetres of pure distilled water to make a normal solution.

A. 316 grammes.

X Q. 55. And the solution you used—how many grammes would be dissolved in a thousand cubic centimetres of pure distilled water?

A. Thirty-one and six-tenths grammes.

X Q. 56. You have taken such time as you desire to verify your last answer and are quite sure of its correctness, are you not?

A. I am.

X Q. 57. Have you with you your notes of the two experiments you made, or that were made in your presence, of manufacturing hydrogen peroxide when the stirring was done by hand and when the stirring was done by machinery?

A. I have got the notes, as I put them down, with me.

X Q. 58. Will you allow me to inspect the same?

A. I will.

X Q. 59. The notes that you have made are of such a char-
216 acter that if they were put in evidence they would not be understood by any one but yourself, would they, without explanation?

A. No; they would not.

X Q. 60. When you made this test describe the burette that you used.

A. It was a Mohr burette. Such a burette is mainly a glass tube of about a foot and a quarter in length, bearing on its face a division of cubic centimetres and fractions of cubic centimetres. The lower part of the glass tube is drawn out to a point, still allowing the liquid to flow out. A suitable piece of rubber hose is slid over this end of the pipe, while into the other opening of the rubber a pointed glass tube protrudes. The rubber itself has a stop-cock outside, which closes it. It was a fifty cubic centimetre burette.

X Q. 61. How much of the permanganate solution of the strength already described did you use, as shown by the divisions on the burette, before you obtained the faint, lasting rose color in the solu-

tion of peroxide of hydrogen containing two cubic centimetres of peroxide solution and the acidulated water mixed with it?

A. Forty-nine cubic centimetres.

X Q. 62. Did you take a note of the quantity of binoxide of barium used in making the peroxide of hydrogen when the stirring was done by hand?

A. I did, and found it to be 114 pounds.

X Q. 63. How much acid was used?

A. The same amount in each case, by measure.

X Q. 64. Question repeated.

A. I cannot tell, but it was the same amount in each case.

X Q. 65. Did you measure the number of gallons of the product of this operation when the stirring was done by hand?

A. I did.

X Q. 66. State what it was.

A. Thirty-seven gallons.

X Q. 67. How did you measure it?

217 A. I weighed the liquid and divided the number of pounds by eight.

X Q. 68. In making peroxide of hydrogen a certain portion of the oxygen always escapes, does it not?

A. It does.

X Q. 69. And there is a waste in comparing the theoretical yield of the operation—that is, the yield that there would be if there was no loss in comparison with the actual yield?

A. I suppose that there is, as in every manufacture.

X Q. 70. Have you calculated the percentage of the loss of oxygen in the operation which you saw when the stirring was done by hand?

A. I have not.

X Q. 71. Will you please do so?

A. I cannot do so, because the necessary data are wanting.

X Q. 72. What data are wanting?

A. In using the raw material it is first treated with water to free it from barium oxide. The washed substance is then subjected to further operation. Not knowing how much was washed away, I cannot absolutely say satisfactorily enough for theoretical calculation how much I used of perfectly pure barium peroxide.

X Q. 73. You made these experiments, did you not, at the request of Mr. Emken, the defendant?

A. I did not.

X Q. 74. At whose request, then?

A. At the request of Mr. Marshall P. Stafford.

X Q. 75. Who was present when you made the experiments?

A. Some workmen of Mr. Emken's factory; in fact, those who did the work; three were there all the time and two were coming, and who had nothing to do with the work.

X Q. 76. The three who were present all the time were assisting in the operation under your direction, were they not?

218 A. They were.

X Q. 77. Previous to your examination to-day had you

read the examination of Mr. Emken or had you been informed of the purport of his deposition or any part of it?

A. I am not aware of any examination of Mr. Emken in this case or of anybody else's.

Redirect by Mr. STAFFORD:

R. D. Q. 78. Was Mr. Emken, the defendant, present during the experiments made by you, about which you have testified?

A. He was not.

R. D. Q. 79. Have you had any conversation or communication of any kind with the defendant about your experiments and the results?

A. I only indicated to him what I was going to do before the experiments were made.

R. D. Q. 80. Have you had any communication with him in any way since you entered upon making the experiments?

A. I have not.

R. D. Q. 81. Was the wash-water used the same in both operations—that is, the one by hand stirring and the one by machine stirring?

A. It was the same in amount and quality.

R. D. Q. 82. How do you know it was the same in quality?

A. It was taken out of the same tub.

Recross by W. H. L. LEE, Esq.:

R. X Q. 83. Which operation was performed first, the hand stirring or the machine stirring?

A. The hand stirring.

R. X Q. 84. Who prepared the acid mixture which was used in both these operations?

A. The hands of the factory.

R. X Q. 85. How do you know that the amount of acid used in each case was the same?

219 A. It run down in each case from a certain mark in a glass vessel down to another mark in the same vessel into the mixture.

R. X Q. 86. Did you test the acids which were placed in this glass vessel to ascertain what they were and their purity?

A. I did not.

R. X Q. 87. What percentage of pure binoxide of barium was there in the commercial binoxide of barium which you used?

A. This I couldn't ascertain correctly because the lots I was going to operate with were, when I came into the factory, under the first treatment with water, so that I could not get a sample for the assay.

X Q. 88. What is the earliest date of which you have positive knowledge of the extensive use of hydrogen peroxide used as a commercial article for bleaching fatty oils?

A. I do not know.

DR. L. H. FRIEDBURG.

Sworn before me—

JOHN A. SHIELDS,
Examiner, &c.

Defendant's counsel offers in evidence four letters of the Patent Office relating to the patent in suit, dated, respectively, August 24, 1882, November 9, 1882, January 8, 1883, and February 7, 1883, the latter being rather a decison of the examiners-in-chief on appeal than a letter, and the same are marked, respectively, Defendant's Exhibits Patent Office Documents 1, 2, 3, and 4, respectively, March 26, 1885, J. A. S., examiner.

220 Counsel for complainant objects to each and every one of the foregoing exhibits as not surrebuttal, as irrelevant and incompetent, and because the same form part of the file wrapper and contents in the matter of the application for the letters patent in suit, and the whole of the same should be put in evidence if any part should.

It is agreed that copies not certified may be used just as if properly certified, subject to correction and to all other objections.

It is admitted by counsel for defendant that in answer to the objections to the granting of the patent in suit arguments in writing were filed, and were made orally, which, so far as they state facts, are covered by the evidence already taken, the result being the allowance of the patent in the form it now is, and therefore complainant's counsel, while insisting upon his other objections, waives his objection to defendant's exhibits just offered, founded upon the fact that the whole of the file wrapper and contents is not put in evidence, it being agreed that complainant shall have the right to put in evidence the remainder of such file wrapper and contents or any part thereof, or any other papers on file in the Patent Office connected with said letters patent, if he elect so to do.

Complainant now gives notice that he insists upon his objections to all defendant's evidence taken in surrebuttal, and insists that defendant had no right to take any such evidence, and gives further notice that at or before the hearing he will move to strike out the same.

Defendant rests.

221 DEFENDANT'S EXHIBIT PATENT OFFICE DOCUMENT 1. March 26, 1885. J. A. S., Ex'r.

Room No. 155. 8, 24, '82.

DEPARTMENT OF THE INTERIOR,
UNITED STATES PATENT OFFICE,
WASHINGTON, D. C., *Aug. 24th*, 1882.

Charles Marchand, care Anthony Pollok, present.

Manufacture of hydrogen peroxide. Filed Aug. 2d, 1882. $6\frac{3}{14}\frac{10}{8}^{7}$.

The above application has been examined. The first claim is for stirring the materials together, and is rejected on Thomson's pro-

cess of making hydrogen dioxide described in Watts' Dictionary of Chemistry, third supplement of Vol. VIII, part II, page 1072. The 2d and 3d claims are rejected on Scherniac and Ganzberg, 222,547, Dec. 9, 1879, chemicals, salines. The 5th claim is rejected because face couplings are in common use in all kinds of machinery, and applicant's device is a face coupling which does not require a specific reference.

THOMAS ANTISELL, *Examiner.*

W. H. S.

222 DEFENDANT'S EXHIBIT PATENT OFFICE DOCUMENT 2. March 26, 1885. J. A. S., Ex'r.

Room No. 155. 11, 10, '82.

DEPARTMENT OF THE INTERIOR,
UNITED STATES PATENT OFFICE,
WASHINGTON, D. C., *Nov.* 9, 1882.

Charles Marchand, care Anthony Pollok, present.

Manufacture of hydrogen peroxide. Filed Aug. 2, 1882. $\frac{68307}{146}$.

The amendment in the above case, filed Oct. 10, has been considered. The screw-stirrer is shown in the Scherniac & Gunzberg reference cited in the last official letter, and the first claim is again rejected on the references already cited. Numerous egg-beaters have a construction similar to the stirrer shown by applicant, as G. Mooney, 216,053, June 3, 1879; also churns, 152,895, July 14, 1874, to Brower; 88016, Mar. 23, 1869, to Deuel, and 2150, Aug. 27, 1861, to Markillie; likewise in soap mixers, Lehman, 131,283, Sept. 10, 1872, and Pritchard, 249,256, Nov. 8, 1881, which references show that a screw-stirrer is so well known as to be the common property of the public for agitating anything, and that it cannot form an element of novelty in a process claim. The 2d, 3d, 4th, 5th, 6th, 8th, and ninth claims are rejected on the above references, in addition to those cited in the previous official letter.

W. H. CHADSEY,
1*st Ass't in Charge.*

W. H. S.

223 DEFENDANT'S EXHIBIT PATENT OFFICE DOCUMENT 3. March 26, 1885. J. A. S., Ex'r.

Room No. 155. 1, 9, '83.

DEPARTMENT OF THE INTERIOR,
UNITED STATES PATENT OFFICE,
WASHINGTON, D. C., *Jan.* 8*th*, 1883.

Charles Marchand, care A. Pollok, present.

Manufacture of hydrogen peroxide. Filed Aug. 2, '82. $\frac{68307}{146}$.

The above case has been considered in view of the argument filed December 21, 1882.

It is not admitted that the mechanical steps of continuous rotation in vertical or any other direction affect the character of the chemical reaction, which forms the principal subject-matter of the application. Applicant desires to perform, on a manufacturing scale, operations heretofore chiefly confined to the laboratory, and in order to do so has selected such apparatus as will suit his purpose. The Scherniac and Gunzberg apparatus, cited as a reference, could be applied to applicant's work without any material alteration, and would cause the eddying motion which he presents as the important novelty. This would therefore be an example of double use of the apparatus and not patentable. Applicant is only entitled to protection for the specific apparatus he has devised. The process described does not present any novelty. The action of the previous official letters is confirmed, and the 1st, 2d, 3d, 4th, 5th, 6th,
224 7th, 8th, and 9th claims are a second time rejected on the references previously cited.

Rendering—

See Black, 47788, 23, 5, 1865.
Branagan, 59350, 6, 11, 1866.

THOMAS ANTISELL, *Examiner.*

W. H. S.

DEFENDANT'S EXHIBIT PATENT OFFICE DOCUMENT 4. March 26, 1883. J. A. S., Ex'r.

No. 7741.

Before the examiners-in-chief, on appeal.

U. S. PATENT OFFICE, *Feb.* 7, 1883.

Application of CHARLES MARCHAND for a patent for an improvement in the manufacture of hydrogen peroxide. Filed Aug. 2, 1882.

The claims rejected are—

"1. The method of making hydrogen peroxide by giving to the acid solution while adding the binoxide thereto a movement of rotation such as is imparted by a screw, substantially in the manner, by the means, and for the purpose set forth.

"2. The method of making hydrogen peroxide by cooling the acid solution, imparting thereto a continuous movement of rotation, as well in vertical as in horizontal planes, such, for example, as imparted by a revolving screw in a receptacle, and adding to said acid solution the binoxide in small quantities, while maintaining
225 the low temperature and the rotary or eddying movements, substantially as described.

"3. The combination of the receptacle for the acids, the means as indicated for cooling the contents of said receptacle, and the screw, substantially as described.

"4. The combination of the hemispherical acid receptacle and the suspended screw occupying the lower contracted part of said receptacle, substantially as described.

"5. The combination of the acid receptacle, the means as indicated for cooling the contents thereof, and the suspended screw provided with perforations or holes in the wings thereof, substantially as described.

"6. The combination with the acid receptacle, the means as indicated for cooling the contents of said receptacle, and the screw suspended in said receptacle so as not to touch the bottom, both said screw and receptacle being formed of or protected with non-corrodible material, substantially as described.

"8. The combination of the receptacle, the power shaft, the screw, and the means for detachably connecting the said screw with said power shaft and for suspending it therefrom in said receptacle, substantially as described.

"9. The apparatus described, comprising, in combination, the receptacle for the acid, the jacketing vessel, the power shaft, the suspended screw, and the means for preventing foreign matter from falling into the receptacle, substantially as set forth."

It seems to be admitted at the outset of the specification (although not directly so stated, as it should be) that it is old to make hydrogen peroxide by adding barium or calcium binoxide mixed with water to some diluted acid, such as sulphuric, nitric, acetic, oxalic,
226 hydrochloric, or hydrofluosilicic acid, the binoxide being added from time to time in small quantities, the vessel in which the operation is conducted being set in a refrigerant and the liquid being agitated or stirred to facilitate the chemical action. The operation of stirring was performed by hand.

In the present case the essence of the invention resides in imparting to the liquid, while making hydrogen peroxide as above, a peculiar motion—one which cannot be given by hand—a continuous movement of rotation, horizontally in opposite directions from the centre, or radially and vertically, or nearly so, according to the shape of the vessel, a vertical motion designated in German as wirbelbewgung, the movement of a smoke ring, making what may be termed a ring vortex.

But the preamble is not thus distinctive. It rather makes the invention appear to reside only in doing by machinery (and consequently, as is generally the case, better) what has hitherto been done by hand.

With proper amendment to the specification, making it clear that the invention is no more than this—that it is no more than in this particular art, all the other steps being old, imparting to the liquid undergoing chemical change this old motion, this motion produced, for example, by the egg-beater—the second claim seems properly to define the operation and may be allowed, but the first claim is incomplete and is too general whereby it is met.

The third and fourth claims are fully met in the references, particularly in the patent of Scherniac & Gunzberg, the designation of the acid receptacle as hemispherical being no limitation, since the specification avers that this vessel may be cylindrical or frustroconical.

The feature of the perforations in the fifth claim and that of the

non-corrodible in the sixth are too common, as shown, to sustain the claims.

227 The eighth claim may be allowed. The ninth claim is limited by the means for preventing foreign matter from falling into the receptacle, for which means the examiner has allowed one claim (claim 7). There can be no objection to including these means in a claim to the entire apparatus. The claim may therefore also be allowed.

The decision is affirmed unconditionally as to claims 1, 3, 4, 5, and 6, and is affirmed subject to suggestion as to claims 2, 8, and 9.

R. G. DYRENFORTH,
R. L. B. CLARKE,
H. H. BATES,
Examiners-in-Chief.

228 U.S. Circuit Court, Southern District of New York. In Equity.

CHARLES MARCHAND *vs.* FREDERICK EMKEN.

Testimony for final hearing taken on behalf of the complainant in the above suit, pursuant to the 67th rule in equity, as amended, of the U. S. Supreme Court, before S. Nelson White, examiner.

NEW YORK, *June 6th*, 1885.

Present: Mr. Lee, for complainant; Mr. Stafford, for defendant.

CHARLES MARCHAND, called and sworn for complainants, says:

Q. 1. Are you the same Charles Marchand who heretofore has been examined as a witness herein?

A. I am.

Q. 2. As a commercial article, what is the purity of binoxide of barium, such as is used in making peroxide of hydrogen, at the present time, and what has it been during the past four or five years?

A. It contains generally from 77 to 87 per cent. of pure anhydrous binoxide of barium. In some cases it contains 90 per cent., and in some other cases it is as low as 70 per cent.

229 Q. 3. Have you read the evidence of the witnesses thus far given in this case?

A. I have.

Q. 4. Several witnesses have testified to the use of different acids in the manufacture of peroxide of hydrogen as a commercial product. State whether or not the acids so used are pure acids.

A. They are not pure acids, as they are mixed up with water in various proportions.

Q. 5. As commercial articles, are the various acids referred to sold pure or in solution with water?

A. They are in solution with water.

Q. 6. Suppose the same amount of binoxide of barium be used in effecting the reaction which occurs in the manufacture of hydrogen peroxide—state whether or not the amount of acid which it is nec-

essary to use to effect a perfect reaction, presupposing there is no loss, will be the same if different acids are used.

A. It will vary.

Q. 7. If there be a series of reactions between a given quantity of binoxide of barium and the different quantities of the various acids which it will be necessary to use in order to make the reactions complete, state whether or not the amount of peroxide of hydrogen produced by such reactions will vary, presupposing the binoxide of barium to be pure and that there is no loss.

Objected to as immaterial, and same objection to all preceding questions except Q's 1 and 3.

A. It will not vary.

Q. 8. State whether or not you have prepared a table showing the result of the reactions between binoxide of barium and the various acids, the amount of the binoxide being in each case the same, and the amount of the acid in each case being sufficient to effect a perfect reaction, it being presupposed that the binoxide of barium
230 and the acids used are chemically pure, and that the reactions are accompanied by no waste.

Same objection.

A. I have, and now produce it.

Paper referred to offered in evidence and marked "Complainant's Exhibit Table of Reactions," S. N. W., ex'r.

Paper objected to as incompetent, irrelevant, and immaterial.

Q. 9. It appears from your evidence and from the table just put in evidence that the amount of peroxide of hydrogen produced has a fixed ratio to the amount of binoxide of barium used, presupposing perfect purity of materials and perfect reaction without loss. Please state whether or not in the practical manufacture of peroxide of hydrogen the actual product of peroxide of hydrogen always bears the same ratio to the commercial binoxide of barium used.

Same objection.

A. No; it will vary; for example, if I have a lot of 400 pounds of binoxide of barium and if I divide it into two lots of 200 pounds each, these two lots being treated separately will not yield the same amount of peroxide of hydrogen.

Q. 10. Please state the causes of this variation.

A. 1st, because the purity of the binoxide of barium is variable and there is no homogeneity in the entire lot; 2d, because during the operation the temperature of the mixture may be too high during a certain amount of time; 3d, because the motion imparted to the mixture may be improper or irregular.

Q. 11. State whether or not the last cause of variance exists when the stirring is done by machinery.

231 A. No; not to any appreciable extent.

Cross-examined by Mr. STAFFORD:

X Q. 12. This table of reactions prepared by you and put in evidence shows nothing but theoretical results, does it?

A. Yes, sir; it is theoretical only.

X Q. 13. Does it pretend to show anything else except theoretical results?

A. No; nothing else.

X Q. 14. The results there indicated would not occur in the practical manufacture of hydrogen peroxide, would they?

A. No.

X Q. 15. Is there any such thing as pure binoxide of barium known in commerce and used in the manufacture of hydrogen peroxide?

A. Yes; there is some, but it is very expensive—too expensive to be used in the manufacture of hydrogen peroxide. It is rather an article of curiosity.

X Q. 16. So far as you know has it ever been used in the manufacture of hydrogen peroxide as an article of commerce?

A. I never used it and don't know of its having been used.

X Q. 17. Are the acids used in the manufacture of hydrogen peroxide as an article of commerce chemically pure?

A. No; they are in solution with water. The acid may be chemically pure by itself, but as it is dissolved in pure water it is a mixture of water and acid; chemically, pure acid is free from water.

X Q. 18. Then this table of reactions put in evidence presupposes both barium and acids in a state in which they are never used in the manufacture of hydrogen peroxide as an article of commerce, does it not?

A. Yes; it is theoretical.

232 X Q. 19. Do you mean to say that if you purchase or manufacture 400 lbs. of binoxide of barium in one lot and then separate it into two lots of 200 lbs. each, by chance or without selection the two lots will not, as a rule, be substantially the same in purity?

A. They cannot be substantially the same.

X 20. When you purchase or sell a quantity of binoxide of barium in commerce is not the percentage of purity agreed upon or understood for the entire lot?

A. No, sir; not concerning the binoxide of barium, because it is affected very rapidly by the presence of water and carbonic acid in the air, which changes its degree of purity.

X Q. 21. Do you purchase binoxide of barium without inquiry or examination as to its quality?

A. Of course not.

X Q. 22. What is meant or referred to by the quality of binoxide of barium when it is dealt in commercially?

A. The amount of pure binoxide of barium contained in the commercial article, which is never warranted to be exact.

X Q. 23. If you were to buy 5,000 lbs. of binoxide of barium how

would you examine it to satisfy yourself as to its quality—by taking a sample from the lot or by a minute examination of the entire lot?

A. I would have to trust the party who sells it to me, because it would be a practical impossibility to select a sample which would be an exact representation of the entire lot. A lot of that importance would be sold with a guarantee of from 80 to 84 per cent., for example.

X Q. 24. If you should undertake to examine a lot of 5,000 lbs. of binoxide of barium so as to state or ascertain its quality, what would you do?

A. I would divide the lot, for example, in 100 lots of 50 lbs. Then I would take a sample of 1 oz. from each 50 lbs., and I would make an analysis of each sample, and the average of the 100
233 analyses should give me a result which would be considered commercially exact, but which would not be actually so.

X Q. 25. Then in doing this you would assume, would you not, that each lot of 50 lbs. from which you took the oz. would average the same quality as that oz.?

A. Yes; and it is precisely for that reason that the result is not exact.

Redirect:

R. D. Q. 26. As scientific facts, state whether or not there is any doubt as to the correctness of the chemical formulæ and reactions shown in "Complainant's Exhibit Table of Reactions."

A. No, sir; there is no doubt at all.

CHAS. MARCHAND.

Sworn to before me—

S. NELSON WHITE,
Examiner, &c.

Complainant rests.

COMPL'T'S EXH. TABLE OF REACTIONS. June 6, '85. S. N. W., Ex'r.

According to the atomic theory the different reactions which take place when chemically pure anhydrous binoxide of barium is brought in contact with different acids will be represented as follows:

Binoxide of barium and hydrochloric acid:

Anhydrous binoxide of barium (BaO_2)	169	lbs.
Hydrochloric acid (Hcl)	73	"
Total	242	"

234 Result of reaction:

Chloride of barium ($BaCl_2$)	208	lbs.
Peroxide of hydrogen (H_2O_2)	34	"
	242	

Binoxide of barium and hydrofluoric acid:

Anhydrous binoxide of barium ($Ba O_2$)	169	lbs.
Hydrofluoric acid (H Fl)	40	"
Total	209	

Result of reaction:

Fluoride of barium ($Ba Fl_2$)	175	lbs.
Peroxide of hydrogen ($H_2 O_2$)	34	lbs.
Total	209	lbs.

Binoxide of barium and hydrofluosilicic acid:

Anhydrous binoxide of barium (Bao_2)	169	lbs.
Hydrofluosilicic acid ($H_2 Si Fl_6$)	144	"
Total	313	"

Result of reaction:

Fluosilicate of barium ($Ba Si Fl_6$)	279	lbs.
Peroxide of hydrogen ($H_2 O_2$)	34	"
Total	313	"

Binoxide of barium and carbonic acid:

Anhydrous binoxide of barium (Bao_2)	169	lbs.
Carbonic acid ($H_2 CO_3$)	62	"
Total	231	"

Result of reaction:

Carbonate of barium ($Ba Co_3$)	197	lbs.
Peroxide of hydrogen ($H_2 O_2$)	34	"
Total	231	"

235 Binoxide of barium and sulphuric acid:

Anhydrous binoxide of barium ($Ba O_2$)	169	lbs.
Sulphuric acid ($H_2 SO_4$)	98	"
Total	267	"

Result of reaction:

Sulphate of barium ($Ba So_4$)	233	lbs.
Peroxide of hydrogen ($H_2 O_2$)	34	"
Total	267	"

By using phosphoric acid ($PO_4 H_3$) the results are the following:

1st. Anhydrous binoxide of barium, $Ba O_2$	169	lbs.
Phosphoric acid ($PO_4 H_3$)	196	"
Total	365	lbs.

Result of the reaction:

Barium phosphate ($Ba H_4 P_2 O_8$)	331	lbs.
Peroxide of hydrogen ($H_2 O_2$)	34	"
Total	365	lbs.

2d. Anhydrous binoxide of barium, Bao_2	169	"
Phosphoric acid ($PO_4 H_3$; $\frac{1}{2}$ as much as in 1st)	98	"
Total	267	lbs.

Result of the reaction:

Bibarium phosphate ($Ba_2 H_2 P_2 O_8$)	233	"
Peroxide of hydrogen ($H_2 O_2$)	34	"
Total	267	lbs.

236

3d. Anhydrous binoxide of barium, Bao_2	169	lbs.
Phosphoric acid ($PO_4 H_3$; $\frac{1}{3}$ as much as in 1st)	$65\frac{1}{3}$	"
Total	$234\frac{1}{3}$	"

Result:

Tribarium phosphate ($Ba_3 P_2 O_8$)	$200\frac{1}{3}$	"
Peroxide of hydrogen ($H_2 O_2$)	34	"
Total	$234\frac{1}{3}$	lbs.

237 At a stated term of the circuit court of the United States of America for the southern district of New York, in the second circuit, held at the United States court-rooms, in the city of New York, on Wednesday, the twenty-eighth day of October, in the year of our Lord one thousand eight hundred and eighty-five.

Present: The Honorable Alfred C. Coxe.

CHARLES MARCHAND
vs.
FREDERICK EMKEN.
(Eq. Cal., Oct. T., '85.)

The above cause coming on this day for final hearing upon pleadings and proofs, Mr. William H. H. Lee is heard in behalf of complainant.

(Further hearing adjourned to 29th inst.)

238 At a stated term of the circuit court of the United States of America for the southern district of New York, in the second

circuit, held at the United States court-rooms, in the city of New York, on Thursday, the twenty-ninth day of October, in the year of our Lord one thousand eight hundred and eighty-five.

Present: The Honorable Alfred C. Coxe.

CHARLES MARCHAND
vs.
FREDERICK EMKEN. } (Eq. Cal., Oct. T., '85.)

The argument in the above cause being resumed this day pursuant to adjournment, Mr. W. H. H. Lee is heard in behalf of complainant; Mr. M. P. Stafford is heard in behalf of defendant.

C. A. V.

239 Circuit Court of the United States, Southern District of New York. In Equity.

MARCHAND *vs.* EMKEN.

COXE, *J.:*

The complainant is the owner of letters patent No. 273,569, granted March 6, 1883, for an improvement in the manufacture of hydrogen peroxide.

The claim in controversy is as follows:

"(1.) The method of making hydrogen peroxide by cooling the acid, solution imparting thereto a continuous movement of rotation, as well in vertical as in horizontal planes, such, for example, as imparted by a revolving screw in a receptacle, and adding to said acid solution the binoxide in small quantities, while maintaining the low temperature and the rotary or eddying movements, substantially as described."

The defenses are lack of novelty and invention and non-infringement.

The invention, as stated in the specification, relates to the manufacture of hydrogen peroxide or oxygenated water by the ad-
240 dition of barium mixed with water to an acid, and it consists in imparting to the acid a movement of rotation, the time required for chemical reaction being thereby lessened, while the reaction itself is more complete. To effectuate this purpose the specification describes and the drawing illustrates an apparatus consisting of a caldron surrounded by a jacketing vessel which contains the cooling medium, and an automatic stirrer provided with helicoidal blades and suspended so as to revolve near the bottom of the kettle. The claim is for this process of making hydrogen peroxide. The application was three times rejected, and was finally allowed by the examiners-in-chief in a qualified form upon the theory that there was as to this particular liquid something magical in the motion imparted by a screw. It is not pretended that the complainant discovered hydrogen peroxide or the method of adding barium mixed with water from time to time to the diluted acid or the necessity for stirring or agitating the liquid; neither did he invent the obliquely bladed screw, the hemispherical receptacle, the jack-

eting vessel, or any part of the apparatus described in the specification. All this was old and well known. The patent itself illustrates how extremely circumscribed was the theater of invention. This is demonstrated by placing side by side two statements taken from the specification, the first describing the prior process and the second the patented process:

241 "Heretofore hydrogen peroxide has been made by adding the barium or calcium binoxide mixed with water to the diluted acid, the binoxide being added from time to time in small quantities, the vessel in which the operation is conducted being set in a refrigerating medium and the liquid being agitated or stirred to facilitate the reaction. The stirring has been performed by hand."

"The (jacketing) vessel B being filled with the cooling medium, the proper quantities of acid and water are placed in the receptacle A.

"The screw C is put in motion and the binoxide of barium or calcium, in the state of a more or less thick emulsion of milk, is added in small quantities. The revolving screw imparts a movement of rotation more or less rapid to the liquid, producing eddies therein and constantly changing the material, and the chemical reaction takes place very regularly and completely."

If the word "machinery" were substituted for the word "hand" at the end of the first quotation the description of the old method would answer as well for the new. The question, then, seems to be narrowed down to this: Does it constitute invention to stir by a well-known and simple mechanical device what had before been stirred by hand? The complainant desired to manufacture in large quantities what had before been produced chiefly in the

212 laboratory. He knew how hydrogen peroxide had been made; every step in the formula was familiar. A mixture that needed stirring and a vessel provided with a revolving stirrer were ready at his hand. He put the former into the latter. This was all. The object of agitating the liquid while making hydrogen peroxide is to keep the barium, which is three times as heavy as water, suspended in the acid, so that its particles may come in contact with the particles of acid. Whether they come in contact while going round, rising, settling, or remaining stationary can make no difference. Divest the case of the air of mystery with which it is environed and it seems simple enough. The complainant's predecessors knew that to keep the barium up in the solution they must stir it. The complainant knew this. Unlike them, however, he manufactured on a scale large enough to make it essential to employ a power shaft. The oar-shaped sticks which formerly went round and round by hand now go round and round by machinery.

Perhaps the clearest statement of the invention from complainant's standing point is found in the evidence of the witness Hedrick. He says:

"The method * * * set out in the complainant's patent * * * is based upon reactions well known in the art and discovered

by Thenard. * * * The dilute acid is given a movement which has never before been imparted to it in the manufacture of
243 hydrogen peroxide and which the patentee claims as new in that art. * * * The liquid is thrown out towards the circumference of the vessel at the bottom, rises at the sides, returns to the center, and then descends to be again thrown out at the bottom, while at the same time it is carried round and round."

Which, being reduced to still simpler language, means that the machine will stir large quantities of the liquid more thoroughly than the hand-worked paddles. He who wishes the sugar and cream which he puts into his coffee to be diffused uniformly through the mixture is quite likely to stir it with a spoon. Should the same individual have occasion to provide coffee for a regiment of soldiers he might, to save time and labor, place it in a ketile provided with a stirrer like complainant's, but to found upon such action a claim for a new process of making coffee would probably be thought absurd.

The pretense that the complainant has discovered some occult and wonder-working power in the motion of a screw revolving in the bottom of a tub is not sustained by the proof. Whether the contents of the tub be oxygenated water or soap or lye or tartaric acid, the action will be the same; that rotary, eddying motions in liquid will result from the revolving screw; that the liquid will rise highest at the periphery of the tub, and thus have the ten-
244 dency at the top to fall towards the center, were well understood operations of centrifugal force.

As every device, apparatus, formula, law of nature, motion, and ingredient adopted by the complainant was old, the patent must be held invalid, unless it can be said that giving to oxygenated water a well-known rotary motion springs "from that intuitive faculty of the mind, put forth in the search of new results or new methods, creating what had not before existed or bringing to light what lay hidden from vision." No such faculty has been tasked in giving form to this patent. There is here no sufficient foundation upon which to rest a claim which, if construed as broadly as the complainant insists it should be, practically makes all pay tribute who stir the mixture in question by machinery, and by hand also, provided substantially the same movement can be produced by hand-stirring, and this seems to be a disputed question upon the proof. The complainant's claim to be enrolled upon the list of inventors is based upon propositions too theoretical and visionary for acceptance. He has but caught a bubble from the "advancing wave of improvement."

As the foregoing considerations must dispose of the cause, it is deemed unnecessary to consider the question of infringement. It would seem, however, in view of the fact that the claim, if upheld at all, must be confined within exceedingly narrow limits, that grave difficulties confront the complainant upon this branch of the
245 case. The defendant uses a tub in which revolves a shaft set with flat blades at right angles to the shaft. The only action of the stirrer is to make the liquid go round and round. In order to

produce a violent agitation he projects from a vertical cleat fastened to the side of the tub two horizontal boards extending nearly to the center. As the shaft revolves the lower blades pass under the lower board and the upper blades pass between the boards. It would seem doubtful, at least, whether the motion thus produced is at all analogous to that described in the patent. It is difficult to discover that which the examiners aptly liken to the movement of the smoke ring. It can hardly be said that there is a "ring vortex" in defendant's tub.

The bill is dismissed.

B. F. Lee and W. H. L. Lee, for complainant; Marshall P. Stafford, for defendant.

246 At a term of the circuit court of the United States for the second circuit and southern district of New York, held in the city of New York, on the 8th day of April, 1886.

Present: Alfred C. Coxe, judge.

CHARLES MARCHAND *vs.* FREDERICK EMKEN. } In Equity.

This cause having been brought on to be heard upon pleadings and proofs at the October, 1885, term of this court, and Mr. W. H. L. Lee having been heard on the part of the plaintiff, and Mr. Marshall P. Stafford on the part of the defendant, and due deliberation having been had—

It is ordered, adjudged, and decreed that the complainant's said bill of complaint be, and the same hereby is, dismissed, with costs and disbursements to the defendant, which have been taxed
247 at the sum of one hundred and ninety-seven $\frac{75}{100}$ dollars.

ALFRED C. COXE.

Form approved:

TURNER, LEE AND McCLURE,
Compl't's Sol'rs.

(Endorsed:) U. S. circuit court, southern district of New York. Charles Marchand *vs.* Frederick Emken. Decree dismissing bill. Marshall P. Stafford, def'ts' sol'r, Nassau street, New York. U. S. circuit court. Filed Ap'l 9th, 1886. Timothy Griffith, cl'k.

248 U. S. Circuit Court, Southern District of New York.

CHARLES MARCHAND *vs.* FREDERICK EMKEN.

We hereby consent that the foregoing papers shall constitute the record to be sent by the clerk of the circuit court of the United States for the southern district of New York to the Supreme Court of the United States on the appeal to said Supreme Court in the above-entitled cause, and that the exhibits in the cause be retained

by the clerk of said circuit court until the hearing of said appeal in said Supreme Court.

New York, June 1st, 1886.

TURNER, LEE & McCLURE,
Comp't's Sol'rs.
MARSHALL P. STAFFORD,
Defendant's Sol'r.

(Endorsed:) Filed June 11th, 1886.

249 U. S. Circuit Court, Southern District of New York. Ap'l Term, 1886. In Equity.

CHARLES MARCHAND *vs.* FREDERICK EMKEN.

From the final decree heretofore entered herein on the ninth day of April, 1886, at this term of this court, directing that the bill of complaint herein be dismissed with costs and disbursements to the defendant, which had been taxed at the sum of one hundred and ninety-seven $\frac{75}{100}$ dollars, the said complainant in open court claims an appeal to the Supreme Court of the United States, and gives good and sufficient security to answer all damages and costs if he fails to make his plea good; which said security being approved
250 by the said court, said appeal is allowed accordingly.

Dated the 30th day of April, 1886.

WM. J. WALLACE.

CITY AND COUNTY OF NEW YORK, *ss:*

Medard J. Baraquin, being duly sworn, says that on the first day of May, 1886, at No. 140 Nassau street, in the city of New York, he served the within appeal in open court on Marshall P. Stafford, complainant's solicitor, by delivering a copy of said notice to a person in charge of said solicitor's office, and leaving the same with him, said solicitor being absent from his office at the time.

MEDARD J. BARAQUIN.

Sworn to before me this 3d day of May, 1886.

JAMES F. HORAN,
Notary Public N. Y. Co.

251 U. S. circuit court. Filed May 3d, 1886. Timothy Griffith, clerk.

252 Know all men by these presents that we, Charles Marchand, of the city, county, and State of New York, as principal, and Ernest Drevet, of the city, county, and State of New York, are held and firmly bound unto Frederick Emken, of New York city, in the sum of four hundred dollars, to be paid to the said Frederick Emken, his executors, administrators, or assigns; for which payment, well and truly to be made, we bind ourselves, our heirs, executors, and administrators, jointly and severally, firmly by these presents.

Sealed with our seals and dated the 23d day of April, 1886.

Whereas at a circuit court of the United States within and for the southern district of New York, in a suit in equity pend-
253 ing in said court between Charles Marchand, complainant, and Frederick Emken, defendant, a decree was rendered against the said complainant; and the said complainant having obtained an appeal to remove the said cause to the Supreme Court of the United States to reverse the decree in the aforesaid suit, and a citation, directed to the said Frederick Emken, citing and admonishing him to be and appear at the October term, 1886, of the Supreme Court of the United States, to be held at Washington, to wit, on the second Monday of October, 1886:

Now, therefore, the condition of the above obligation is such that if the said Charles Marchand shall prosecute his said appeal
254 to effect and answer all damages and costs if he fails to make his plea good, then the above obligation to be void; otherwise to remain in full force and virtue.

CHAS. MARCHAND. [L. S.]
ERNEST DREVET. [L. S.]

In the presence of—
FREDERICK GELLER.

STATE, CITY, AND COUNTY OF NEW YORK, *ss:*

On this twenty-third day of April, 1886, before me personally came Charles Marchand and Ernest Drevet, to me known and known to me to be the individuals described in and who executed the foregoing bond, and they severally acknowledged that they executed the same.

[L. S.] WILBUR F. SMITH,
Notary Public, N. Y. Co.

255 STATE, CITY, AND COUNTY OF NEW YORK, *ss:*

On this twenty-third day of April, 1886, before me personally came Ernest Drevet, to me known, and being by me duly sworn, did depose and say that he resides at No. 850 East 137th street, in the city of New York; that he is worth twice the sum specified in the above bond over all the debts and liabilities which he owes or has incurred and exclusive of property exempt by law from levy and sale under any execution, and is a householder in the State of New York.

ERNEST DREVET.

Subscribed and sworn to before me this 23d day of April, 1886.

[L. S.] WILBUR F. SMITH,
Notary Public, N. Y. Co.

256 The foregoing bond is approved this 30th day of April 1886.

WM. J. WALLACE.

Endorsed: U. S. circuit court, southern district of New York. Charles Marchand *vs.* Frederick Emken. Bond on appeal. Turner, Lee & McClure, solicitors for appellant, 20 Nassau street, New York. U. S. circuit court. Filed Apr. 30th, 1886. Timothy Griffith, clerk.

257 By the Hon. William J. Wallace, one of the judges of the circuit court of the United States for the southern district of New York.

UNITED STATES OF AMERICA, *Southern District of New York,* } *ss:*

To Frederick Emken, Greeting:

Whereas from the whole of the decree lately made by the circuit court of the United States for the southern district of New York in a certain cause wherein Charles Marchand was complainant and Frederick Emken was defendant the said complainant has appealed to the Supreme Court of the United States, and has taken his appeal in open court, and has given good and sufficient surety to
258 prosecute his said appeal to effect and answer all damages and costs:

Therefore you are hereby cited and admonished to be and appear at a Supreme Court of the United States to be holden at Washington on the second Monday of October, 1886, pursuant to said appeal, to show cause, if any there be, why the decree so appealed from as aforesaid should not be corrected and reversed and why speedy justice should not be done to the parties in that behalf.

Witness the Hon. William J. Wallace, judge of said circuit court, at the city of New York, on this 30th day of April, 1886.

WM. J. WALLACE.

(Endorsed:) U. S. circuit court, southern district of New
259 York. Charles Marchand *vs.* Frederick Emken. Citation on appeal. Turner, Lee & McClure, solicitors for appellant, 20 Nassau street, New York.

CITY AND COUNTY OF NEW YORK, *ss:*

Medard J. Baraquin, being duly sworn, says that on the first day of May, 1886, at 140 Nassau street, in the city of New York, he served the within citation on appeal on Marshall P. Stafford, Esq., complainant's solicitor, by delivering a copy of said citation to a person in charge of said solicitor's office and leaving the same with him, said solicitor being absent from his office at the time.

MEDARD J. BARAQUIN.

Sworn to before me this 3d day of May, 1886.

JAMES F. HORAN,
Notary Public, N. Y. Co.

260 [Endorsed:] U. S. circuit court: Filed May 3d, 1886. Timothy Griffith, clerk.

261 UNITED STATES OF AMERICA, *Southern District of New York*, } *ss:*

I, Timothy Griffith, clerk of the circuit court of the United States of America for the southern district of New York, in the second circuit, do hereby certify that the foregoing pages, numbered from one to two hundred and sixty, inclusive, contain a true and complete transcript of the record and proceedings had in said court in the case of Charles Marchand, complainant & appellant, against Frederick Emken, defendant & appellee, as the same remain of record and on file in said office.

In testimony whereof I have caused the seal of the said court to be hereunto affixed, at the city of New York, in the southern district of New York, in the second circuit, this 11th day of June, in the year of our Lord one thousand eight hundred and eighty-six, and of the Independence of the said United States the one hundred and tenth.

[Seal of U. S. Circuit Court, South. Dist. New York.]

TIMOTHY GRIFFITH, *Clerk.*

Endorsed on cover: S. New York C. C. U. S. No. 292. Charles Marchand, appellant, *vs.* Frederick Emken. Filed June 23, 1886.

 SUPREME COURT OF THE UNITED STATES.

CHARLES MARCHAND, Appellant,
vs.
FREDERICK EMKEN, Appellee.
} October Term, 1888. No. 292.

Whereas by stipulation heretofore made herein and bearing date June 1st, 1886, it was agreed between the parties hereto that the exhibits in the above-entitled cause be retained by the clerk of the circuit court of the United States for the southern district of New York until the hearing of the appeal herein in the Supreme Court of the United States;

And whereas from the record, as printed on appeal, certain exhibits have been omitted which are essential to the intelligible understanding of the same:

Now, therefore, it is stipulated and agreed between the parties hereto that the following exhibits introduced in evidence in the court below and marked as follows be printed and added to the record on appeal in the above-entitled cause, viz:

 "Complainant's Exhibit B, November 11, 1884, J. A. S., examiner."

"Complainant's Exhibit Sketch, May 27, 1884, J. A. S., examiner."

"Complainant's Exhibit Sketch B, Nov. 8, 1884, J. A. S., ex'r."

"Complainant's Exhibit Sketch C, Nov. 11, 1884, J. A. S., examiner."

"Complainant's Exhibit Sketch D, Nov. 11, 1884, J. A. S., examiner."

"Complainant's Exhibit Sketch E, Nov. 11th, 1884, J. A. S., examiner."

Dated New York, March 22, 1889.

B. F. LEE,
Counsel for Appellant.
WM. C. ROBERTS,
Counsel for Appellee.

 [Endorsed:] Supreme Court of the United States. Charles Marchand *vs.* Frederick Emken. No. 292. Oct. term, 1888. Stipulation as to printing exhibits.

 MARCHAND *vs.* EMKEN.

COMPLAINANT'S EXHIBIT B. Nov. 11, 1884, J. A. S., Examiner.

(2–175.)

21234. $1.55.

DEPARTMENT OF THE INTERIOR.

[Vignette.]

UNITED STATES PATENT OFFICE.

To all persons to whom these presents shall come, Greeting:

This is to certify that the annexed is a true copy from the records

of this office of the specification and drawing in the matter of the letters patent granted Charles Marchand March 6, 1883, number 273,569, improvement in manufacture of hydrogen peroxide. Application for same was filed complete August 2, 1882.

In testimony whereof I, R. G. Dyrenforth, acting Commissioner of Patents, have caused the seal of the Patent Office to be affixed this 13th day of October, in the year of our Lord one thousand eight hundred and eighty-four, and of the Independence of the United States the one hundred and ninth.

Seal Patent Office, United States of America.

R. G. DYRENFORTH,
Acting Commissioner.

(Here follows diagram marked p. 5.)

6 UNITED STATES PATENT OFFICE.

CHARLES MARCHAND, of New York, N. Y.

Manufacture of Hydrogen Peroxide.

Specification forming part of Letters Patent No. 273,569, dated March 6, 1883; application filed August 2, 1882. (No model.)

To all whom it may concern:

Be it known that I, Charles Marchand, of New York city, in the county and State of New York, have invented a new and useful improvement in the manufacture of hydrogen peroxide, which improvement is fully set forth in the following specification.

This invention has reference to the manufacture of hydrogen peroxide or oxygenated water by addition of barium or calcium binoxide to an acid (sulphuric, nitric, acetic, oxalic, hydrochloric, hydrofluoric, hydrofluosilic, and the like), the binoxide having been mixed with water.

Heretofore hydrogen peroxide has been made by adding the barium or calcium binoxide, mixed with water, to the diluted acid, the binoxide being added from time to time in small quantities, the vessel in which the operation is conducted being set in a refrigerating medium, and the liquid being agitated or stirred to facilitate the reaction. The stirring has been performed by hand.

The present invention is based on the fact or discovery that the reduction of the barium or calcium binoxide takes place under conditions much more favorable in point of rapidity and yield when the acid to be neutralized is given a movement of rotation both vertically and horizontally by a screw or other suitable means, which at the same time creates both constant and ever-changing eddies, the said movement of rotation being imparted continuously during the addition of the binoxide.

The present invention consists, therefore, first, in imparting to the acid a movement of rotation, the time required for the chemical

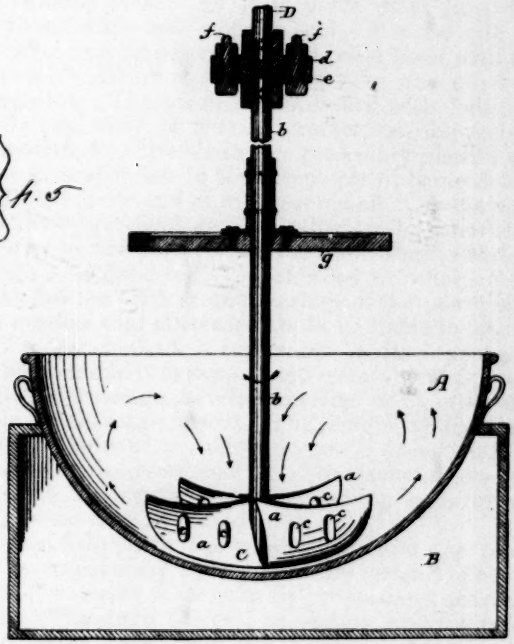
(No Model.)

C. MARCHAND.

MANUFACTURE OF HYDROGEN PEROXIDE.

No. 273,569. Patented Mar. 6, 1883.

No. 292.
Marchand
v.
Ewken.
fig. 5



Witnesses:
E. E. Masson
Philip Mellus

Inventor
Charles Marchand
by A. Pollok
his Atty

reaction being thereby lessened, while the reaction itself is more complete.

The apparatus shown in the accompanying drawing is preferably employed, and forms also part of the invention. A view in vertical section and elevation is given.

A is the receptacle for the acid; B, a jacketing-vessel for containing the refrigerant or cooling medium; C, the screw, and D a vertical power-shaft. The acid-receptacle need not be of any particular size, but a good capacity is from five hundred to one thousand gallons. It is preferably hemispherical, but may be cylindrical, frustoconical, or other suitable form; and it is made of or lined with material adapted to resist the action of the acid. For use with hydrofluoric acid, a sheet-iron or, better, a copper vessel lined with lead may be used, or one of platinum, gold, or silver, or one otherwise rendered non-corrodible. The screw C is provided with helicoidal blades *a*, ordinarily two, three, or four in number, set obliquely on the arbor or screw-shaft *b*. The blades are preferably pierced with holes *c*. The screw is suspended in the receptacle A, being detachably connected with the lower end of the power-shaft D by the pieces *d e*—one fixed to the power-shaft and the other to the screw-shaft, and clamped together by the bolts *f*. On the screw-shaft, above the top of the receptacle A, is fixed a disk, *g*, of wood or other suitable material, which catches the oil from the bearings of the power-shaft, and other foreign matters that otherwise would be liable to fall into the receptacle. The power-shaft is suspended in its bearings by suitable collars, which enable it to support the screw C, and is driven from a horizontal shaft through beveled gearing, or by other well-known or suitable mechanical means. The length of the screw-shaft is such that the blades of the screw do not in operation touch or scrape the interior of the receptacle A. The jacketing-vessel B is of ordinary or suitable construction. The cooling medium commonly employed therein may be placed in it.

The vessel B being filled with the cooling medium, the proper quantities of acid and water (say twenty parts, by weight, of acid to one hundred parts of water, or other suitable proportions) are placed in the receptacle A. The screw C is put in motion, and the binoxide of barium or calcium, in the state of a more or less thick emulsion or milk, is added in small quantities. The revolving screw imparts a movement of rotation more or less rapid to the liquid, producing eddies therein and constantly changing the material, and the chemical reaction takes place very regularly and completely. Sufficient binoxide is added to secure the complete neutralization of the acid without rendering hydrogen peroxide too alkaline. After a certain time, which varies with the quantity of the article manufactured and the amount of binoxide employed, and during which the screw may be stopped, but is preferably kept in revolution, the production of the hydrogen peroxide is finished. It only remains to allow the matters in suspension to settle and to decant the clear liquor.

7

If it is desired to obtain the hydrogen peroxide in a state of greater purity than results from the above, the clear liquor is subjected to

special chemical treatment, which, as it constitutes no part of the present invention, need not be described.

I claim the new improvements herein described, all and several, to wit:

1. The method of making hydrogen peroxide by cooling the acid solution, imparting thereto a continuous movement of rotation, as well in vertical as in horizontal planes—such, for example, as imparted by a revolving screw in a receptacle—and adding to said acid solution the binoxide in small quantities while maintaining the low temperature and the rotary or eddying movements, substantially as described.

2. The combination of the receptacle, the screw suspended therein so as not to touch the bottom, and the protecting or covering disk carried by the screw-shaft, substantially as described.

3. The combination of the receptacle, the power-shaft, the screw, and the means for detachably connecting the said screw with said power-shaft and for suspending it therefrom in said receptacle, substantially as described.

4. The apparatus described, comprising in combination the receptacle for the acid, the jacketing-vessel, the power-shaft, the suspended screw, and the means for preventing foreign matter from falling into the receptacle, substantially as set forth.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

CH. MARCHAND.

Witnesses:
R. S. HAYWARD.
G. H. PEARSALL.

[Stamped:] U. S. circuit court. Filed Feb. 18, 1886. Timothy Griffith, clerk.

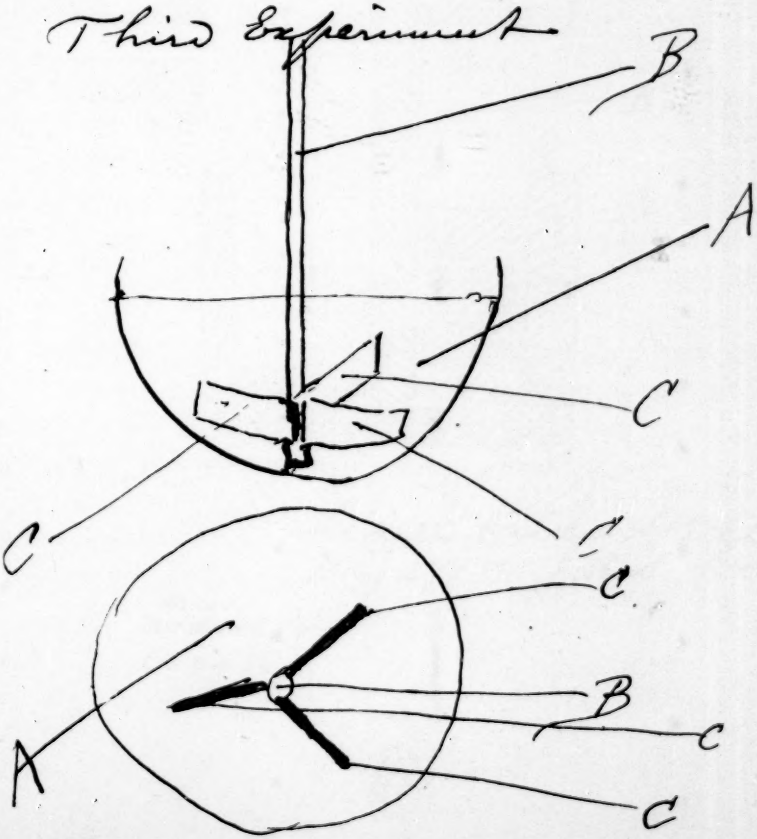
(Here follow diagrams marked pp. 8 to 12, incl.)

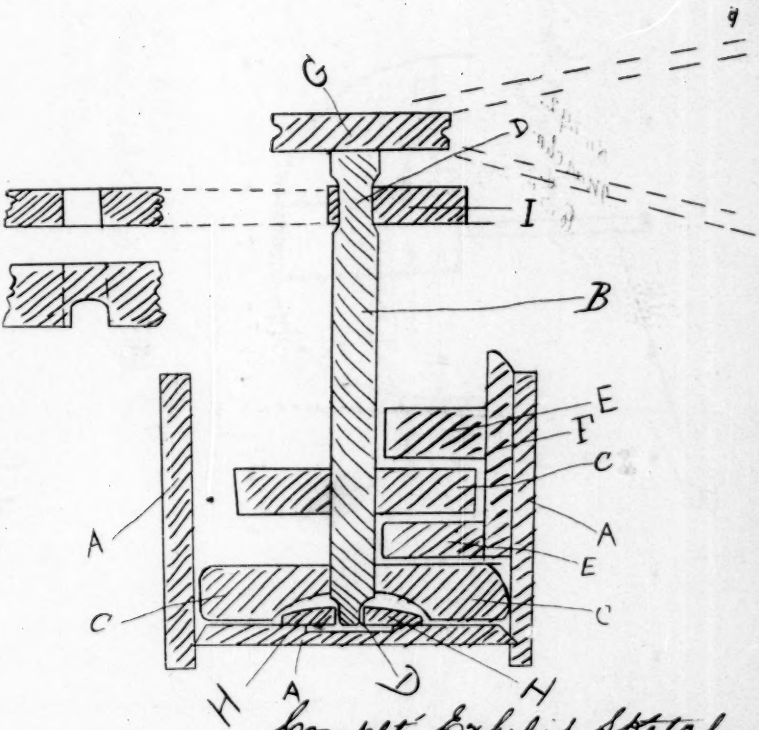
13 [Endorsed:] Supreme Court U. S. 1888, October term. No. 292. Charles Marchand, appellant, *vs.* Frederick Emken. Stipulation of counsel & addition to record. Filed March 27, 1889.

Marchand vs. Emken
Complainant's Exhibit E. Welch E.
Nov. 11th 1889
J. A. S. Examiner

No. 292
Marchand
Emken
p. 8

Third Experiment



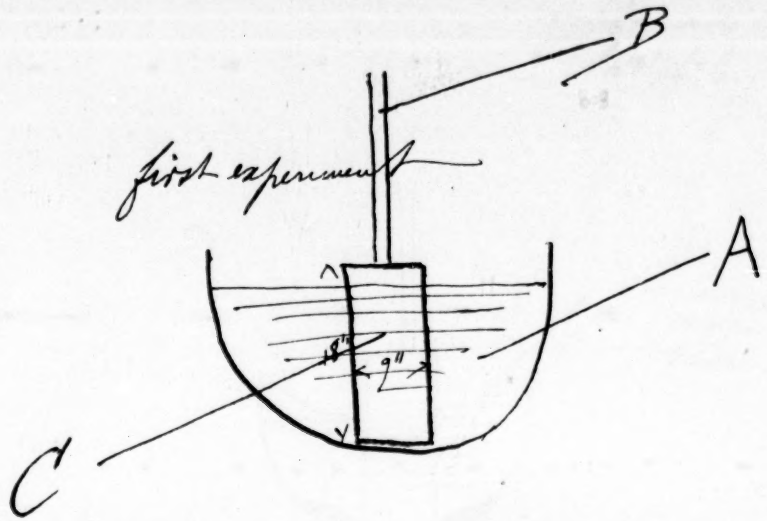


Complete Exhibit Sketch
May 27/84 J.A.S. Exr

No. 292
Marchand
v.
Emken
} p. 9

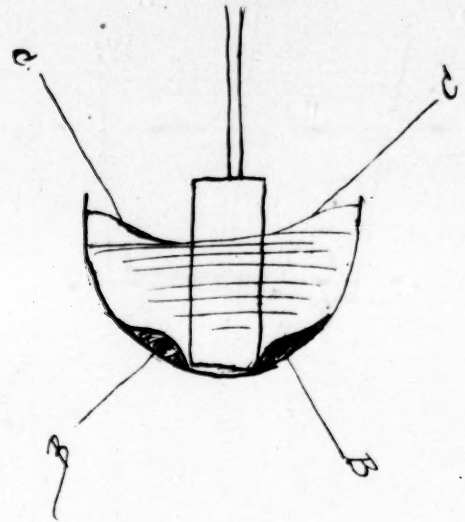
Marchand
v
Emken

"Complainants
Exhibit Sketch
B. Nov. 8. 1884
J. A. S. Esq"



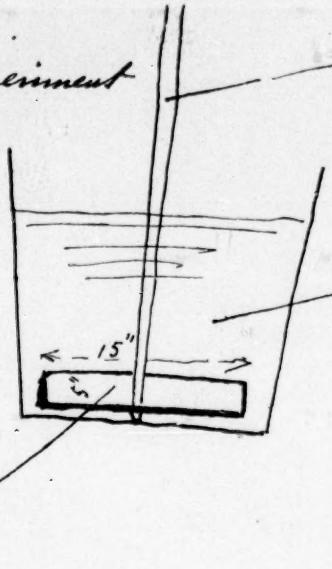
No. 292
Marchand } p 10.
Emken }

"Marchand vs Emken"
Complainant's Exhibit
Sketch C. Nov. 11-1886
J. A. B. Examiner



No. 292.
Marchand } p. 11
Emken.

Second experiment



No. 292.
Marchand
v.
Emken
p. 12.

Marchand
vs
Emken
Complainant's
Exhibit
Sketch
D. Nov. 11
1884. J.A.S
Examr.

Supreme Court of the United States.

OCTOBER TERM, 1888—No. 292.

CHARLES MARCHAND, APPELLANT,

vs.

FREDERICK EMKEN.

Brief for Appellant.

B. F. LEE,
W. H. L. LEE,
Of Counsel.

M. B. Brown, Printer and Stationer, 49 & 51 Park Place, N. Y

Supreme Court of the United States.

CHARLES MARCHAND,
Appellant,

vs.

FREDERICK EMKEN,
Appellee.

Brief for Appellant.

Statement of the Case.

This is an appeal from a final decree of the Circuit Court of the United States for the Southern District of New York, Judge Coxe presiding, entered April 9, 1886, dismissing the bill in a suit brought for infringement of Letters Patent No. 273,569, dated March 6, 1883, granted to Charles Marchand for improvement in the manufacture of hydrogen peroxide. The bill is in the usual form and was filed February 26, 1884.

Of the defenses set up in the answer, but two were insisted upon at the hearing. These were that the improvement described in the plaintiff's patent was not patentable, and that there was no infringement.

The opinion of the Court sustained both these defenses, the principal question discussed being that of the patentability of the subject matter.

The first claim of the patent in suit is alone involved

Assignments of Error.

The appellant specifies the following errors upon which he relies, and in regard to which the decree is alleged to be erroneous:

1. In that the Court below decreed that the invention embracing and forming the subject-matter of the first claim of Letters Patent No. 273,569, dated March 6, 1883, to Charles Marchand, is wanting in patentable novelty.

2. In that the Court below decreed that no claim for infringement of the first claim of said letters patent can be sustained by the appellant against the appellee.

3. In that the Court below decreed that the bill of complaint filed by the appellant against the appellee be dismissed, and that the appellee recover of the appellant his costs, charges and disbursements, to be taxed by the Clerk of the Court below, and that said appellee have execution therefor.

4. In that the Court below did not adjudge the first claim of said letters patent to be valid, and that the appellee had infringed the same, and in that it did not enter the usual decree for injunction, and account of profits and damages with costs in favor of the appellant.

These assignments of error involve the patentability of the first claim of the patent and the infringement thereof.

Brief of the Argument.

State of the Art and Nature of the Invention.

Before examining the specification, it is necessary to an intelligent understanding of it, to review the state of the art as it existed at the time of Marchand's

invention, and consider the nature and peculiar qualities of peroxide of hydrogen.

The chemical formula of peroxide of hydrogen is H_2O_2. It is therefore known as oxygenated water, also as dioxide of hydrogen.

A molecule of peroxide of hydrogen contains the same number of atoms of hydrogen as water and double the number of atoms of oxygen.

The additional atom of oxygen is very loosely bound to the other elements (pp. 62, 95, 96, 99).

This substance was discovered by Thenard in 1818 (pp. 24, 94).

It is so unstable a compound, that pure peroxide of hydrogen has probably never been obtained (p. 34, x-*Q*. 70, p. 99); it is always mingled with water. Comparatively pure peroxide of hydrogen, however, is a product of the laboratory, and not the commercial article, the manufacture of which the patent affects.

The commercial article known as peroxide of hydrogen is an aqueous solution, of which peroxide of hydrogen generally forms from 2 to $3\frac{1}{2}$ per cent. in volume of the whole (pp. 42, 43, 52, 54, 126), though for special purposes it has been made as strong as $5\frac{1}{4}$ per cent. (p. 58).

Its strength is generally measured by its "volumes capacity." Thus the expression "ten volumes capacity" means that if one were to decompose one quart of commercial hydrogen peroxide, the result of the decomposition will be 10 quarts of oxygen gas and one quart (approximately) of pure water. Every $4\frac{3}{4}$ volumes capacity indicates approximately one per cent. of peroxide of hydrogen in the solution (p. 54, Marchand, *Q*. 95; Hedrick, p. 88. See also p. 99).

This substance is produced by the decomposition of binoxide of barium with various acids in the presence of water (p. 76, Hedrick x-*Q*. 86.)

Binoxide of barium has a specific gravity three times as great as water (p. 58 Marchand *Q.* 120; p. 37, Emken x-*Q.* 94).

As a commercial product it is not chemically pure but is mingled with oxide of iron, oxide of manganese and other impurities (pp. 53, 101). The commercial article contains from 70 to 90 per cent of chemically pure binoxide of barium (pp. 135, 115 x-*Q.* 94.)

Pure hydrogen peroxide has a specific gravity of 1 3 (p. 34, Emken x-*Q.* 70). For all practical purposes the specific gravity of the commercial article may be considered to be the same as that of water.

The various acids which are used to make peroxide of hydrogen as a commercial article, are in solution with water (p. 135).

The *theoretical* yield from the reaction of pure binoxide of barium with various acids is well known. The amount of peroxide of hydrogen always bears a fixed ratio to the binoxide of barium; that is 169 pounds of barium will produce 34 pounds of peroxide of hydrogen. The amount of different acids required to react upon a given amount of barium varies greatly (pp. 136-140).

The *practical yield is very different from the theoretical yield, owing to the great instability of the compound, and the difficulties incident to the manufacture of peroxide of hydrogen are due to this instability.*

The escape of oxygen during the process of manufacture means a loss of just so much in the product.

At a temperature of 65°–70° F., oxygen begins to escape in the form of gas. What remains is water. The rapidity of decomposition increases with the temperature (pp. 95, 96.)

The reaction itself between the barium and the acid produces heat and a consequent loss of oxygen, and if

a large number of particles of barium come in contact with a large number of particles of acid within a small space, the heat is the greater, and consequently there is an increased loss of oxygen. Hence the necessity of keeping the mass cool during the process of manufacture.

The problem to be solved to bring the waste to a minimum, is to evenly distribute the minute particles of barium all over the liquid, and not allow it to concentrate at any one place. The barium being nearly three times as heavy as the aqueous solution, this is manifestly a most difficult problem.

But this is not the only obstacle to be overcome. Peroxide of hydrogen is comparatively stable in an acid solution but is unstable in a neutral or alkaline solution. If, therefore, in any part of the liquid mass the amount of binoxide of barium is more than sufficient to react upon the acid in its immediate proximity, and at that point it comes in contact with the peroxide of hydrogen already formed, the latter is decomposed and oxygen escapes.

Then again, if at any one point the peroxide of hydrogen in the solution becomes too concentrated, the likelihood of escape of oxygen is increased, as the stronger the solution, the more unstable it is.

Hedrick's cross cross-examination on these topics is instructive (pp. 76–78, x-*Q.* 91–103). We quote part of it :

"x-*Q.* 101. Please state again what are the dangers "or unfavorable presences around the hydrogen "peroxide as it first results from reaction in the pro- "cess of manufacture?

"*A. First, rise of temperature due to the combination* "*of the barium with the acid; second, the existence of* "*the peroxide of hydrogen in a state of approximate* "*purity at those points where the reaction has just taken* "*place; third, the absence of acid at that point (peroxide*

" *of hydrogen being more stable in an acid than in a neu-*
" *tral or alkaline solution) ; fourth, the presence, in con-*
" *tact with the peroxide of hydrogen, of the barium binox-*
" *ide, including the impurities, which the article as actually*
" *made and used contains.* * * *

" X-*Q.* 103. Then will you explain more fully the " nature and causes of the second difficulty mentioned ?

" *A.* The nature is simply that when peroxide of hydrogen is formed, it is of course first produced, and " then dissolved in the surrounding liquid ; so that for " a time it exists in a nearly pure state, or certainly in " a very concentrated solution, and that in this form it " is much more ready to part with its extra equivalent " of oxygen than if it is mixed with or diffused " through much water."

Prior to the complainant's invention, the state of the art was this : The acid solution was put into a tub and binoxide of barium was added little by little, or the acid solution and the binoxide of barium were each added in small quantities from time to time, the acid solution was cooled, and the mass was agitated by stirring with a stick shaped like an oar, which agitated the liquid and to a certain extent lifted up the barium which had settled and was settling, and tended to diffuse it throughout the mass. The labor required to do this was of so arduous a nature that no one man could do it for the necessary time (p. 18) ; one man must relieve another (pp. 18, 40). Such labor also required intelligent guidance (p. 53).

It was palpably impossible, by such means, to produce such a motion in the whole of a large tub, as would cause an even distribution of the fine particles of barium throughout the liquid mass, prevent the mass from becoming neutral or alkaline at any one point, and prevent the peroxide of hydrogen from becoming concentrated at any one point.

The difficulties in the manufacture of this article were well recognized by scientists (Miller's Chemistry,

1868, pp. 94–95; Fowne's Chemistry, 1878, p. 96; Watts, 1875, 1879 and 1881, pp. 96–100; Wurtz, 1876, pp. 100–103; Roscoe & Schorlemmer, 1878, pp. 103–104; Payen, 1878, pp. 104–105; Chemical Society Journal, 1881, p. 106).

By the methods in use prior to the plaintiff's invention it was possible to make 20 to 30 gallons of peroxide of hydrogen at one operation (Kionka, p. 11; Marchand, p. 17).

The object to be attained was to so stir the mass as to avoid loss of oxygen, to substitute inexpensive machine work for expensive hand labor, *and to eliminate as a necessary factor the continuous active supervision of an intelligent mind during the progress of the process, and substitute therefor the automatic action of a machine.*

Peroxide of hydrogen is probably the most effective bleaching agent in existence. Its utility had long been appreciated, and for years prior to the complainant's invention scientists had stated that the great expense of its manufacture alone prevented its extensive use in the arts.

The reaction between the binoxide and the acid upon contact is practically instantaneous. The difficulty was to produce such conditions as to cause that contact to be uniformly distributed throughout the whole mass. The theoretical perfection to be attained was this: The amount of *acid should be exactly sufficient to react upon the proper quantity of binoxide of barium, the distribution of the acid and the barium should be exactly uniform throughout every part of the entire mass,* the mass of course to be kept cool enough to prevent the escape of oxygen by the action of heat, it being remembered that the very fact of reaction evolves heat. Under such a theoretical condition there would be no loss of oxygen.

The complainant made a long step toward this by the use of a simple mechanical contrivance well-

known, in its general features, which dispensed with human labor and intelligent supervision, produced a different class of motions in the whole mass from that possible by methods previously adopted, kept such motions uniform during the entire operation, and effected a saving of from 25 to 30 per cent. in materials used (p. 52, *Q.* 71 ; p. 54, *Q.* 94), as well as an improvement in the product (p. 54).

The Patent.

The specification of the patent is as follows: (See small book.)

Be it known that I, Charles Marchand, of New York City, in the county and State of New York, have invented a new and useful Improvement in the Manufacture of Hydrogen Peroxide, which improvement is fully set forth in the following specification.

This invention has reference to the manufacture of hydrogen peroxide or oxygenated water by addition of barium or calcium binoxide to an acid (sulphuric, nitric, acetic, oxalic, hydrochloric, hydrofluoric, hydrofluosilic, and the like), the binoxide having been mixed with water.

Heretofore hydrogen peroxide has been made by adding the barium or calcium binoxide, mixed with water, to the diluted acid, the binoxide being added from time to time in small quantities, the vessel in which the operation is conducted being set in a refrigerating medium, and the liquid being agitated or stirred to facilitate the reaction. The stirring has been performed by hand.

The present invention is based on the fact or discovery that the reduction of the barium or calcium binoxide takes place under conditions much more favorable in point of rapidity and yield, when the acid to be neutralized is given a movement of rotation both vertically and horizontally, by a screw or other suitable means, which, at the same time, creates both constant and ever-changing eddies, the said movement of rota-

tion being imparted continuously during the addition of the binoxide.

The present invention consists, therefore, first, in imparting to the acid a movement of rotation, the time required for the chemical reaction being thereby lessened, while the reaction itself is more complete.

The apparatus shown in the accompanying drawing is preferably employed, and forms also part of the invention. A view in vertical section and elevation is given.

A is the receptacle for the acid; B a jacketing-vessel for containing the refrigerant or cooling medium; C the screw, and D a vertical power-shaft. The acid-receptacle need not be of any particular size, but a good capacity is from five hundred to one thousand gallons. It is preferably hemispherical, but may be cylindrical, frusto-conical, or other suitable form; and it is made of or lined with material adapted to resist the action of the acid. For use with hydrofluoric acid, a sheet-iron or, better, a copper vessel lined with lead may be used, or one of platinum, gold, or silver, or one otherwise rendered non-corrodible. The screw C is provided with helicoidal blades *a*, ordinarily two, three, or four in number, set obliquely on the arbor or screw-shaft *b*. The blades are preferably pierced with holes *c*. The screw is suspended in the receptacle A, being detachably connected with the lower end of the power-shaft D by the pieces *d e*—one fixed to the power-shaft and the other to the screw-shaft, and clamped together by the bolts *f*. On the screw-shaft, above the top of the receptacle A, is fixed a disk, *g*, of wood or other suitable material, which catches the oil from the bearings of the power-shaft, and other foreign matters that otherwise would be liable to fall into the receptacle. The power-shaft is suspended in its bearings by suitable collars, which enable it to support the screw C, and is driven from a horizontal shaft through beveled gearing, or by other

well-known or suitable mechanical means. The length of the screw-shaft is such that the blades of the screw do not in operation touch or scrape the interior of the receptacle A. The jacketing-vessel B is of ordinary or suitable construction. The cooling medium commonly employed therein may be placed in it.

The vessel B being filled with the cooling medium, the proper quantities of acid and water (say twenty parts, by weight, of acid to one hundred parts of water, or other suitable proportions) are placed in the receptacle A. The screw C is put in motion, and the binoxide of barium or calcium, in the state of a more or less thick emulsion or milk, is added in small quantities. The revolving screw imparts a movement of rotation more or less rapid to the liquid, producing eddies therein and constantly changing the material, and the chemical reaction takes place very regularly and completely. Sufficient binoxide is added to secure the complete neutralization of the acid without rendering the hydrogen peroxide too alkaline. After a certain time, which varies with the quantity of the article manufactured and the amount of binoxide employed, and during which the screw may be stopped, but is preferably kept in revolution, the production of the hydrogen peroxide is finished. It only remains to allow the matters in suspension to settle and to decant the clear liquor.

If it is desired to obtain the hydrogen peroxide in a state of greater purity than results from the above, the clear liquor is subjected to special chemical treatment, which, as it constitutes no part of the present invention, need not be described.

I claim the new improvements herein described, all and several, to wit:

1. The method of making hydrogen peroxide by cooling the acid solution, imparting thereto a continuous movement of rotation, as well in vertical as in horizontal planes—such, for example, as imparted by a revolv-

ing screw in a receptacle—and adding to said acid solution the binoxide in small quantities while maintaining the low temperature and the rotary or eddying movements, substantially as described.

2. The combination of the receptacle, the screw suspended therein so as not to touch the bottom, and the protecting or covering disk carried by the screw-shaft, substantially as described.

3. The combination of the receptacle, the power-shaft, the screw, and the means for detachably connecting the said screw with said power-shaft and for suspending it therefrom in said receptacle, substantially as described.

4. The apparatus described, comprising in combination the receptacle for the acid, the jacketing-vessel, the power-shaft, the suspended screw, and the means for preventing foreign matter from falling into the receptacle, substantially as set forth.

In testimony whereof, I have signed this specification in the presence of two subscribing witnesses.

CH. MARCHAND.

Witnesses:

R. S. HAYWARD.
G. H. PEARSALL.

The Opinion of the Court below and Comments upon it.

This opinion is printed at pages 141–144.

The learned Judge seems to have followed the defendant's counsel even to the extent of adopting as the complainant's positions those which defendant's counsel erroneously assumed to be such.

We had hoped that the disavowal of such positions, both in oral argument, and in the brief in reply, submitted after the hearing, would have sufficed to pre-

vent the Court from using language, the natural inference from which is, to attribute views to complainant's counsel, which the latter never urged, and never deemed sound.

The gist of the learned Judge's opinion may be found in that part of it, wherein he says, referring to Hedrick's description of the invention (p. 143) "Which "being reduced to still simpler language, means that "the machine will stir large quantities of the liquid "more thoroughly than the hand-worked paddles. He "who wishes the sugar and cream which he puts into "his coffee to be diffused uniformly through the mix-"ture is quite likely to stir it with a spoon. Should the "same individual have occasion to provide coffee for "a regiment of soldiers, he might, to save time and "labor, place it in a kettle provided with a stirrer like "complainant's, but to found upon such action a claim "for a new process of making coffee would probably "be thought absurd."

This quotation shows that the learned Judge did not appreciate the difference between a stable and an unstable compound. The product of mixing a given amount of coffee, milk and sugar will result in no loss, however the stirring be done, although the character of the motion imparted may affect the time of thoroughly completing the mixture. If some one had invented a process of stirring coffee by machine power, which not merely saved hand labor and intelligent supervision, but caused a different character of motion to be imparted to the liquid from that which was possible by hand, saving from twenty-five to thirty per cent. of the materials used, *by preventing loss, due to the unstable character of the resultant product*, and effected an improvement in the product itself, there could be no question, but that the inventor would be entitled to a patent for an improvement in the manufacture of coffee.

But the learned Judge says what Marchand did was obvious. He says (p. 142): "The complainant desired "to manufacture in large quantities what had before

" been produced chiefly in the laboratory. He knew " how hydrogen peroxide had been made, every step in " the formula was familiar. A mixture that needed " stirring and a vessel provided with a revolving stirrer " were ready at his hand. He put the former into the " latter."

This is the old story. An inventor accomplishes a most valuable result by simple means, and the multitude stand gazing by, see how simple it all is after he has done, and then say, " Any one could do that."

The answer to all this is, why did not some one do it, if it was so obvious. It is not the fact that hydrogen peroxide, up to the time of the complainant's invention, was principally a laboratory product.

The defendant's expert, Friedburg, testifies to its use as a bleaching agent for many articles twelve years prior to March, 1885, and says " it was made largely in London " (p. 127).

Roscoe & Schorlemmer, 1878, speak of it as " an article of commerce " (p. 104).

Watts [1881], (p. 100), gives directions for preparing it " in considerable quantity."

It had been imported into this country prior to December, 1879, when Marchand began its manufacture here (pp. 45–46).

There was a fortune awaiting any one who could so reduce the cost of peroxide of hydrogen as to make its use as a bleaching agent for numerous articles sufficiently economical, provided efficient patent protection could be obtained.

What is so obvious to the learned Judge was never done by any one either in this country or in any foreign country, until the complainant did it; and it was not obvious to the complainant. To obtain the result required experiments extending over seven months and an expenditure of $1,500 (pp. 47–50).

Experiments in dealing with large quantities of binoxide of barium were very expensive. The cost of binoxide of barium was formerly about $1.75 per pound (p. 52), and to waste this material by allowing the oxygen to escape involved considerable pecuniary outlay.

The complainant was educated in Paris, and graduated as Engineer of Arts and Manufactures in 1871, at the Ecole Centrale des Arts et Manufactures. Since then he has been a manufacturing analytical chemist (p. 15). In December, 1879, he began the manufacture of hydrogen peroxide. It was not until March, 1881, that he adopted his present device. During the seven months, in which he was making his experiments in machine stirring, he was studying over the matter nearly all the time, until he obtained the result (p. 50, *Q.* 60).

The fact that the result attained was well known to be desirable and that no one had done it before, and the fact that it took Mr. Marchand seven months to perfect his invention and at an expenditure of $1,500, would seem conclusive that the invention was not obvious.

Mr. Marchand was exceptionally well qualified by education and employment to deal with this subject.

It is worthy of notice that the case of Bene *vs.* Jeantet, 47 O. G., 402, was decided by this Court principally upon the expert testimony of Mr. Marchand, wherein he testified to the efficacy of peroxide of hydrogen and other bleaching agents in bleaching and refining coarse hair.

Again, the Court speaks of the necessity of stirring the solution to keep the barium up, and that this fact was known to the complainant and his predecessors. The Court adds (p. 142): "Unlike them, however, "he manufactured on a scale large enough to make "it essential to employ a power shaft. The oar-

"shaped sticks which formerly went round and "round by hand, now went round and round by "machinery."

These statements are not justified by anything in the record. The oar-shaped sticks did not go round and round in the sense that the complainant's apparatus does. An essential feature of the oar hand-motion was the lifting of the binoxide of barium from the bottom and giving it an upward impetus, and this to a certain extent avoided concentration at the bottom.

The difficulty is that the learned Judge has completely lost sight of the fact, that, in the manufacture of this article, there is a *great difference between the theoretical and the practical yield.* He disregards the fact, that, be as careful as you may, there will always be a loss of material, but that *proper methods of stirring will produce conditions which will prevent loss to any great extent.* These conditions in hand stirring are produced only by labor of the most arduous description with intelligent guidance.

These results in the complainant's machine stirring are produced by giving that kind of motion which will prevent the occurrence of adverse conditions.

The latter part of the quotation from the learned Judge's opinion shows, that he has not appreciated the nature of the article. Favorable conditions could not be produced by simply making the oars go round and round, as one might stir coffee with a spoon. Such a method of stirring, whether by hand or machine, would obviously cause great waste. Marchand's first experiments show this (pp. 47–49 and Complt's Exh. Sketch B). The mere fact, that the learned Judge suggests this, is a strong argument in favor of the patentability of the subject matter. Notwithstanding the two days argument of this case and the elaborate briefs on each side, he has failed to grasp the conditions necessary to economy in manufacture. The fact that he did not do so, and that Mr. Marchand not merely understood the

conditions most favorable to economy, but also after experimenting for seven months, selected proper means for producing these conditions, would seem to be conclusive upon the question of invention.

This is not a border-line case. If the learned Judge's and the defendant's views are correct, and the only change involved was, in making a mere perfunctory motion in a large mass instead of in a small one, and in doing on a large scale, what had formerly been done on a small scale—producing by machine power a motion well known in the art, which could just as well be produced by unintelligent hand labor, if the laborer had sufficient strength,—then there is nothing, which anywhere near approaches patentability, in the complainant's improvement.

If, on the other hand, the complainant has adopted a new motion, such as in this art was never before imparted to the mass, as a whole, which is to be stirred—if such method effects a great economy in material used, as well as an almost total saving of intelligent labor, and at the same time improves the product, his improvement is of such a character, that it is far removed beyond the doubtful border-land between invention and ordinary mechanical skill.

Still further is it removed, if the change that the inventor has effected, was one long desired in the arts, the utility of the product sought to be manufactured being well known, and the sole obstacle to its extensive use being its great cost.

Still further is the question removed from doubt, when the result is obtained by a man especially qualified by education and training to solve the problem, who only reaches it after protracted study of the subject, after numerous experiments and at considerable expenditure.

Marchand's Improvement supplied a want long felt, was not obvious, was of great utility, and is therefore patentable.

In such cases as these there would seem to be three crucial questions:

1. Was the want of the patented improvement felt by those interested in the subject matter?

2. If the want was known was the improvement obvious?

3. Is the improvement useful?

1.

Such want had been often expressed.

THE VALUE OF HYDROGEN PEROXIDE IN THE ARTS HAD BEEN LONG WELL KNOWN, BUT THE EXPENSE OF MAKING IT HAD INTERFERED WITH ITS PRACTICAL USE.

As early as 1845 it was known that "*this liquid* "*bleaches and destroys all vegetable colors*" (p. 94.)

A similar fact is set forth in Miller's Elements of Chemistry [1868], viz.: "Hydric dioxide bleaches a "solution of litmus and many vegetable colors" (p. 95).

In Fowne's Elementary Chemistry [1878] it is stated that this liquid "presents the aspect of a colorless, "transparent, inodorous liquid, *possessing remarkable bleaching powers*" (p. 96).

In Wurtz's *Dictionnaire de Chimie* [1876] says—translation (p. 103):

"Uses.—Binoxide of hydrogen has been employed "to restore old designs and oil paintings whose colors "have been altered by the slow action of hydrosul- "phuric acid (otherwise sulphuretted hydrogen) upon

" the white lead. The oxygenated water by transform-
" ing this black sulphide of lead into white sulphate of
" lead, causes the black stains to disappear. Water
" feebly charged with oxygen ought always to be used.
" A beautiful design of Raphael damaged by black
" stains in the parts heightened with white was cleaned
" with the acid of oxygenated water containing at most
" five to six times its volume of oxygen. The paper,
" colored with a light shade of bistre, had not received
" the slightest alteration."

Roscoe & Schorlemmer's "Treatise on Chemistry" [1878] says (p. 104) :

"An aqueous solution of hydrogen dioxide *is an*
" *article of commerce*, and is used for the purpose of
" cleaning and bleaching old and stained engravings
" and oil paintings. The dioxide has also been em-
" ployed as an auricome for bleaching dark-colored
" hair."

Payen's Industrial Chemistry [1878], after referring to the use of hydrogen peroxide in restoring white colors in pictures that had turned gray or black, and stating that such restoration has been effected by making use of water containing two per cent. by measure of peroxide of hydrogen, says :

"*If hydrogen peroxide were cheaper it might be used*
" *with advantage for cloth bleaching*" (p. 105).

In Wagner & Gautier [1879], in enumerating bleaching agents, it speaks of :

"4th. Peroxide of hydrogen ; *but this last named can*
" *only be considered a substance whose application to*
" *bleaching is still in the future*" (p. 105).

In Rudolph von Wagner's work, "Technology" [1881], it is said :

"Hydrogen peroxide has lately been *applied to a*
" *considerable extent to the bleaching of feathers for*
" *ornament, silk and hair*" (p. 105).

In an article on this subject in the *Druggist & Chemist* [1881], it is stated :

" Hydrogen peroxide is however, a valuable agent " for bleaching hair, ivory, oil, wax, tobacco and blood " serum, and for cleaning old engravings and oil " paintings ; for these purposes its solution should be " made strongly alkaline by addition of the strongest " ammonia.

" *The use of the peroxide for the above purposes on the* " *large scale is very much limited by its costly nature, and* " *any cheap method of preparation would largely extend* " *its sale* " (p. 106).

See also, Friedburg (pp. 125–126, x-*Q.* 23–25, p. 127, x-*Q.* 43–45).

2.

The complainant's improvement was not obvious.

The facts bearing on this subject have already been sufficiently marshaled.

3.

The complainant's invention is useful.

The complainant may be said to have completed his invention in March 1881. None of the extracts from scientific works (pp. 94 to 106), suggest the possibility of machine-stirring ; on the contrary they indicate the stirring operation as one requiring most careful and intelligent hand manipulation. The dates of publication of these various works run from 1845 to 1881.

Kionka says that from 1881 to 1883 he was engaged in making peroxide of hydrogen and did the stirring by hand and that one person could make about 20 gallons at a time (p. 11).

Marchand says that the largest vessel, which could be conveniently used, when the stirring was done by hand, had a capacity of from 40 to 45 gallons, in which 30 gallons could be conveniently stirred. The labor involved was very severe, for reasons, which the witness explains, and it was necessary to employ two men, one relieving the other (pp. 17–18).

Complainant, when he testified in June, 1884, had then ten kettles, two of 150 gallons and eight of 70 gallons, to all of which one person could easily attend, and his duties were very light (pp. 21–22, *Q.* 41–45). These ten kettles would be about equal to forty kettles of the size formerly used, to work which would require *eighty men instead of one man.*

At about that time the complainant put in a kettle of a capacity of 800 gallons, and when he was subsequently examined in November, 1884, he had used this since the preceding July, and had made 720 gallons at one operation (p. 52).

As the operation of hand stirring required careful and constant manipulation, it would obviously be impossible for one person to see that each laborer did his work properly, and it was necessary either to run the risk of loss by improper manipulation or to employ, at a high price, skilled laborers (pp. 52-53, *Q.* 81–82). Even the defendant admits that the complainant's process saves labor.

In addition to the saving of labor there is a great saving of material. The complainant explains this in answer to *Q.* 25, which, as well as a few succeeding questions and answers, we will quote (pp. 19–20):

" When the movement is given by hand it is very irregular, and does not stir the whole mass at the same time, and consequently it allows the binoxide of barium to settle at the bottom of the kettle, because the stick used can only put in motion the binoxide of barium

when it touches it. By my patented process the movement of rotation in both ways, horizontally and vertically, prevents the particles of binoxide of barium to settle at the bottom of the kettle, and consequently the particles are constantly kept in suspension in the mass, which makes the chemical reaction a very regular one without any interruption, whereas in stirring by hand it is perfectly impossible to obtain the same result.

"*Q.* 26. Why is it that the binoxide of barium tends to settle at the bottom?

"*A.* Because the specific gravity or density of *binoxide of barium is about three times greater than the density of the liquid, and it settles down very easy.*

"*Q.* 27. You say that by the settling of the binoxide of barium, that which settles is prevented from coming in contact with the acid solution; how does this interfere with the perfection of the process, and tend to make it less effective?

"*A.* When the particles of binoxide settle at the bottom the chemical reaction is temporarily interrupted, and after a while when the particles are put in motion they are brought in contact with the acid, and the result of this interruption occasions a loss of oxygen gas which escapes, and consequently does not combine with hydrogen to make peroxide of hydrogen. The yielding is then diminished in a proportion which varies with the irregularity of the movement.

"*Q.* 28. Then as I understand it, the most perfect and economical reaction is obtained when every particle of the binoxide of barium is constantly brought in contact with new parts of the acids. State whether or not this is correct?

"*A.* Yes, sir; there is no doubt about it.

"*Q.* 29. Please state, whether or not, the method of making peroxide of hydrogen claimed in the first claim of your patent sued upon, can be practiced by hand?

"*A.* No, sir; it cannot.

"*Q.* 30. Then, so far as the motion imparted by hand, and the motion of your patent are concerned, state

what, if any, are the distinctions of the character of the motion produced by hand, and that produced by your process and apparatus?

"*A. The motion imparted by hand could never bring in contact every particle of binoxide of barium with new parts of acid, whereas by my patented process, the movement changes constantly the surfaces in contact, and consequently the chemical reaction has no interruption.*

"*Q.* 31. The claim of your patent speaks of a continuous movement of rotation, as well in vertical as in horizontal planes; please state whether or not there is any advantage in this complex movement, and also whether or not there is any difference in this respect between your process and the process of manufacture by hand?

"*A.* There is a great advantage in this complex movement claimed in my patent, and *it is an impossibility to obtain such movement by hand;* the difference has been explained by me previously.

"*Q.* 32. State whether it is possible to regulate the rapidity of movement more readily and exactly by your method or by hand?

"*A.* It is very easy to regulate the rapidity of movement by my patented method, and it is impossible to do so by hand."

This evidence gives an outline of the reasons why there must be a difference in the economy of the yield.

The extent of loss when the stirring is done by hand, as practically shown, is generally from 25 to 30 per cent., according to the care of the laborer, although with laborers of exceptional skill it would be much less. In case of a large kettle the laborer could not stir it at all.

When the complainant did his stirring by hand he used *two pounds* of binoxide of barium to make a gallon of peroxide of hydrogen of 12 *volumes* capacity, and *one and two-thirds pounds* to make a gallon of peroxide of hydrogen of 10 *volumes* capacity (p. 54, *Q.* 94.) Now that

he does his stirring by machinery, he uses *nine pounds* of binoxide of barium to make *five gallons* of peroxide of hydrogen of 15 *volumes* capacity (p. 52, *Q.* 71). This shows a saving of about 25 per cent.

The instability of the oxygen in peroxide of hydrogen after it has been made, and the liability of the additional atom of oxygen to escape, are sufficiently explained in the extracts from scientific works in evidence.

The principal causes are,—that binoxide of barium, as a commercial product, is never pure; it is mixed with oxide of iron, oxide of manganese, etc., etc., which causes decomposition; because too great an amount of binoxide of barium will accumulate in one place, so that although it is decomposed and the oxygen is taken from it, there is not sufficient acid in immediate contact to complete a chemical union so as to form peroxide of hydrogen, but it escapes in the air; because where the peroxide of hydrogen is allowed to accumulate in any one spot, so that the solution at that point becomes highly concentrated, the oxygen will escape, for the instability of hydrogen peroxide increases very rapidly with the concentration of the solution; and because if the acid is not properly diffused, the peroxide of hydrogen, being at certain points in an alkaline or neutral solution, is much more unstable and liable to decompose.

The cost of peroxide of hydrogen, which was $9.60 *per gallon in* 1879, *was in* 1884 $1.60 *per gallon* (pp. 46, 51.)

While a portion of this reduction is undoubtedly due to the reduced cost of binoxide of barium, it is largely due to complainant's improved method of manufacture. It is highly probable that if the obstacles to economical stirring had not been removed, there would have been no sufficient incentive to improved methods in the manufacture of binoxide of barium.

If our views of the facts are correct, Marchand's improvement is clearly patentable, under the decisions of this Court. It is a well known principle that the simplicity of the means will not defeat a patent provided the result be useful.

Loom Co., *vs.* Higgins, 105 U. S., 580.

This case is very analogous to that at bar. The patent was for a combination, all the elements of which were old. The Court says (p. 589):

"We find that although it produced a great improve-
"ment in the art of weaving pile fabrics, yet, as actually
"exhibited in conception and accomplishment, it seems
"simple."

After showing the nature of the mechanism and the state of the art, the Court proceeds to dispose of the defense that the combination was an aggregation of old devices and not patentable (p. 591).

"This argument would be sound if the combination
"claimed by Webster was an obvious one for attaining
"the advantages proposed—one which would occur to
"any mechanic skilled in the art. But it is plain from
"the evidence, *and from the very fact that it was not*
"*sooner adopted and used*, that it did not, for years, occur
"in this light to even the most skillful persons. It may
"have been under their very eyes, they may almost be
"said to have stumbled over it, but they certainly failed
"to see it, to estimate its value, and to bring it into
"notice. * * * Now that it has succeeded, it may
"seem very plain to any one that he could have done it
"as well. This is often the case with inventions of the
"greatest merit. It may be laid down as a general rule,
"though, perhaps, not an invariable one that if a new
"combination and arrangement of known elements pro-
"duce a new and beneficial result, never attained before,
"it is evidence of invention. *It was certainly a new and*
"*useful result to make a loom produce fifty yards a day*
"*when it never before had produced more than forty;* and

"we think that the combination of elements by which "this was effected, even if those elements were separ- "ately known before, was invention sufficient to form the "basis of a patent."

The patent in suit was criticized in the Court below, because it did not set forth in the specifications all the advantages claimed for it.

A patentee is entitled to all the uses and advantages incident to his invention, whether he appreciates them or not, and if an advantage follows directly from an invention the patentee is entitled to such advantage, even though nothing is said about it in his specification.

Stow *vs.* Chicago, 104 U. S., 550.
Brown *vs.* The District of Columbia, 47 O. G., 398, 401.

The Defendant's Evidence.

Thus far we have not considered the defendant's evidence. The purport of it is that hand stirring is as economical of material as machine stirring, and produces as effective a result.

The defendant testifies to nothing of any importance that occurred earlier than December, 1882. The application for the patent was filed in August, 1882, and the invention was completed in March, 1881.

When the defendent began to make peroxide of hydrogen in December, 1882, he used the apparatus attacked in this suit. On a few occasions, when the machinery broke down, defendant claims to have made fifty or sixty gallons of peroxide of hydrogen, the stirring being done by hand, and subsequently 150 gallons (pp. 31, 108), and that the results were just as good, in economy of material, and in time. The 150 gallons were mixed in an apparatus made since this suit was begun. Although these operations were witnessed by

men in his employ who would doubtless be friendly witnesses, they were not called (p, 111).

The defendant also states that he kept memoranda of these operations (pp. 108, 115–116), but they were not produced.

It is barely possible, that the class of motion described in the complainant's patent, could be so far imitated in hand stirring, as to produce the results stated. It is also possible, that improved methods of manufacturing binoxide of barium, and pouring it into the mass in a finely divided, creamy state, may have so far facilitated the operation, as to make such results, as the defendant describes, possible.

These statements, however, rest on the defendant's evidence alone, and his testimony is entirely unworthy of credence. Take, for instance, the following extract from his evidence (p. 29):

"*Q.* 25. Prior to that time (December, 1882) how had you stirred the mixture in making hydrogen peroxide?

"*A. I stirred it with a stick, by hand.*

"*Q.* 26. Why did you not use a mechanical stirrer in manufacturing hydrogen peroxide prior to December, 1882?

"*A. Because I had no demand for a sufficiently large quantity of hydrogen peroxide to warrant the putting up of a mechanical stirring apparatus.*"

After a long cross-examination it appeared that *all he had ever done prior to that time was to make about a pint out of curiosity in his kitchen, seven years before* (pp. 37–39; x–*Q.* 98–115).

When experimental tests were made by his expert to compare the comparative results of machine stirring and hand stirring the amount used in each case was 37 gallons (p. 129).

In one instance alone did he have accurate data as to the comparative economy of hand stirring with machine

stirring. In that case he made by *machine stirring* 75 *gallons*, and *by hand stirring about* $\frac{1}{225}$*th of a pint* (p. 115). He says that his yield by hand stirring was about 15 per cent better than that obtained by machine stirring. Of course, it is well known that small quantities of peroxide of hydrogen can be made to almost any strength, and that the waste is diminished; but, supposing there were but 5 per cent. loss of oxygen in the smaller quantity there was then a loss of at least 20 per cent in the larger.

This is to be contrasted with Emken's statement (p. 107, *Q.* 1), where he swears the loss is 12 per cent. below 'theoretical yield,' by either machine or hand stirring."

Friedburg's Evidence.

He appears to have had no special knowledge, either practical or scientific, in regard to the manufacture of peroxide of hydrogen; what he saw in March, 1885, four years after the completion of the invention, is of very little value. There is no evidence to show that the hand stirring, which then took place, was under the conditions which existed four years before that, when the invention was made; but these experiments are of value as showing Emken's bad faith.

The experiments were made by Emken's employees.

There is nothing in the world easier than to make an unsuccessful experiment, if it is desired to do so.

The amount of binoxide of barium used was 114 pounds in each case to make 37 gallons (p. 129). The waste must have been enormous. The strength was $4\frac{3}{16}$ per cent. *by weight*, equal to about *thirteen volumes* capacity (p. 126).

The amount of binoxide of barium used averaged more than *three pounds to a gallon.*

Marchand is accustomed to make a solution of *fifteen volumes* capacity, using *nine pounds* to make *five gallons*, a little less than two pounds to a gallon (p. 52, *Q.* 71).

Emken stated that he used but *two hundred* pounds to make *one hundred and fifty* gallons of a strength of about *three and one-half per cent.* (p. 112).

The waste of material in both these operations witnessed by Friedburg is very much greater than could have been obtained by ordinary hand stirring. The complainant himself testified that such loss would generally be from 25 to 30 per cent. (p. 52).

The fact probably is, that the workmen took care, to secure a poor result in the machine stirring, and undertook to hide this trick, by being sufficiently careless with the hand stirring, to make the two results equal.

It is significant, however, that when it was designed to show to a presumably intelligent expert, what results could be accomplished by hand stirring, the quantity made was 37 gallons and not 150, and it took *three* men to do the work (p. 129).

As to the rest of the evidence of Friedburg, it suffices to say that his knowledge of machine stirring was entirely derived from the one so-called test, that he saw, and that he is not a witness, competent to compare the results of the two kinds of stirring.

In his attempt to explain how it was that peroxide of hydrogen as a bleaching agent was so little used for many years, he says, that—

"Until about *twelve* years ago * * * it was not "generally known that peroxide of hydrogen could be "kept in a watery acidulated solution for any consid- "erable length of time without decomposing" (p. 127).

Now the complainant made his invention some four years only prior to the time that the witness testified.

Friedburg's testimony strengthens the evidence we have already given, showing, that although the utility of peroxide of hydrogen had been well known, and its powerful bleaching qualities, and although for many years scientific men had been on the alert, for some practical method, by which it could be cheaply produced, no one actually did devise a cheap method of production, until the complainant did so.

Infringement.

From what has already been said, it is apparent, that Marchand was the first person, who, in the practical manufacture of peroxide of hydrogen, imparted such motions to the liquid, that the whole mass of the liquid was, to such an extent agitated by currents, running up and down as well as round and round, and following each other with such frequency, and regularity, as to prevent an accumulation of the barium, and distribute it throughout the entire mass of the liquid with uniformity; and this by machine power.

The inventor is therefore entitled to a liberal construction of his patent.

Tilghman *vs.* Proctor, 102 U. S., 707.
Clough *vs.* Barker, 106 U. S., 166, 177.
Consolidated Valve Company *vs.* Crosby Valve Company, 113 U. S., 157.
O'Reilly *vs.* Morse, 15 Howard, 62, 115, 116.
Morley Sewing Machine Company *vs.* Lancaster, 47 O. G., 267, 270–272, and cases there cited.

The apparatus used by the defendant is proved by the evidence of Kionka (pp. 8–12); Marchand and Hedrick both testified on the subject of infringement (pp. 15–16, 22–23, *Q.* 49; pp. 67–68, 91–93).

The defendant's apparatus was old and well known long prior to the date of complainant's invention

(pp. 125, 29). It consists of a tub, on the side of which is placed a narrow, vertical board, extending to within a short distance of the bottom of the tub; extending down in the centre of the tub is a vertical power shaft, which rests on a guide in the bottom of the tub, at the lower end of which shaft are two wings which revolve just above the bottom of the tub; a short distance above this, on the power shaft, there are two somewhat shorter wings; attached to the board on the side, above referred to, are two narrow pieces of board extending horizontally in the direction of the power shaft; these two pieces of board are so arranged in relation to the wings that when the shaft revolves, carrying the wings with it round and round, the lower wings will pass between the bottom of the tub and the lower of the two horizontal boards, and the upper wings will pass between the two horizontal boards.

Complainant's exhibit, sketch, being the second drawing after figure 4, small book, with the evidence of Kionka (pp. 8–10), give all necessary explanation of this simple apparatus.

When it is remembered that these wings revolve 50 to 100 times per minute, according to Kionka, and 25 per minute, according to Emken (pp. 10–30), it is apparent that constant movements of rotation will be kept up in the liquid mass, in vertical as well as in horizontal rotation. We contend that these motions are within the general category of motions described and sought to be produced in the complainant's patent; at all events, they are the equivalent thereof, and as such within the scope of the invention.

The defendant's claim to a radical difference in the motion produced is not grounded on fact.

It is to be noticed, that although the defendant swears, that the same kind of motion can be produced by hand stirring, as can be produced by complainant's apparatus, almost in the next breath he attempts to show important

differences, between the motion of his own apparatus, and that of the complainant, and then says, that substantially the same thing would occur in his own apparatus, whether the stirring were done by hand, or by machine (pp. 30–31; *Q.* 30–38).

It is quite significant, however, that when he undertook the hand stirring he altered his tubs (p. 114, x-*Q.* 87).

The learned Judge in the Court below, referring to the claim of the patent in suit, says, that such a claim "if construed as broadly as the complainant insists it "should be, practically makes all pay tribute who stir "the mixture in question by machinery." No such contention is made on the part of the complainant. The device, for instance, which complainant first adopted (and which is shown in Complainant's Exhibit, sketch B and Sketch C, being the third and fourth figures after page 4 of small book), would not produce the character of motion claimed in the first claim of the plaintiff's patent, and would not be within the patent. The defendant is free to use that and countless other stirring devices which will not produce the complex rotary motions of the complainant's apparatus, in the entire mass.

Whether or not such a motion as complainant's apparatus effects could be produced by hand stirring it is profitless to inquire; such stirring could never compete with machine stirring. There is no evidence that it was produced prior to the complainant's invention.

If the statement of the learned Judge were true, it would be no reason for holding the patent void. The proper course would be to require the complainant to enter a sufficient disclaimer, and thus limit the claim to his real invention.

We submit, however, that the claim is properly drawn and is good as it stands, and that the defendant infringes the same.